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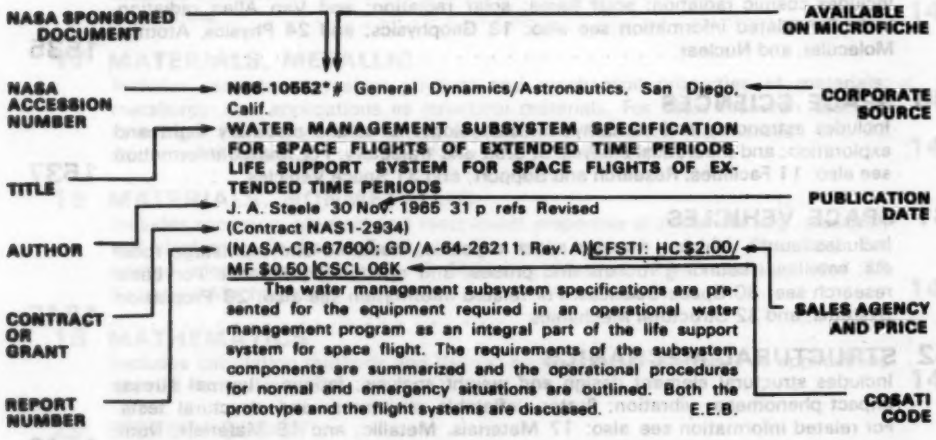
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N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
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TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
AUTHOR
J. A. Steele 30 Nov. 1965 31 p refs Revised
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
CONTRACT OR GRANT
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The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
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May 8, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-18585# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

INTERFERENCE EFFECTS PRODUCED BY GASEOUS SIDE-JETS ISSUING INTO A SUPERSONIC STREAM

F. Maurer 22 Nov. 1965 89 p refs Transl. into ENGLISH from Deut. Forschungsanstalt für Luft- und Raumfahrt Rept.-65-04, Jan. 1965

(Contract NOw-62-0604-c)

(TG-230-T460; AD-626568) CFSTI: HC $3.00/MF $0.75

Experimental and theoretical investigations are of a gaseous control jet from slot nozzles of finite length into a gaseous main stream at supersonic speeds. The experimental work is restricted to injection of cold air into a wind tunnel flow over a flat plate at zero angle of attack. The experimental results consist of pressure distributions and normal force coefficients, as well as schlieren and oil-film photographs. On the basis of the observed results, a model is developed for analytical approximation. The calculated results, compared with the measured results, show the influence of the various parameters and give a better understanding of the flow processes. Author (TAB)

N66-19033*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

TRANSONIC PRESSURE DISTRIBUTIONS OVER PROTUBERANCES AND ADJACENT AREAS IN PROXIMITY TO THE NOSE OF A LAUNCH VEHICLE

James A. Blackwell, Jr. Washington, NASA, Mar. 1966 36 p refs

(NASA-TN-D-3216) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A wind-tunnel investigation was conducted over a Mach number range from 0.40 to 1.20 to determine the pressure distributions over protuberances and adjacent areas in proximity to the nose of a launch vehicle. The Reynolds number of the investigation varied with Mach number over a range of 2.30×10^6 per foot to 3.17×10^6 per foot (0.701×10^6 per meter to 0.966×10^6 per meter). The angle of attack varied from about $-10°$ to $10°$. The results of the investigation indicate that the variation in pressure coefficient over the forward portion of the protuberance mounted closest to the nose is similar to the variation over the forward portion of the protuberance mounted farthest from the nose; however, there is some variation in the pressure coefficient distribution over the rearward portion of the protuberances. Also, there is an extremely rapid buildup of a negative pressure-coefficient peak of large magnitude rearward of the protuberance cone-cylinder juncture over a small Mach number range as the surface pressure coefficients approach and exceed sonic values. Author

N66-19193# General Electric Co., Philadelphia, Pa. Missile and Space Div.

COMPARISON OF THEORETICAL AND EXPERIMENTAL INDUCED PRESSURE SKIN FRICTION REDUCTION AND ZERO LIFT TOTAL DRAG FOR A POINTED 7.5° POROUS CONE IN PRESSURE OF TURBULENT MASS ADDITION

C. J. Studerus 23 Apr. 1965 27 p refs

(Rept.-65SD325)

Turbulent mass addition tests have recently been run at Mach numbers of 6 and 10 from which experimental data have been obtained for changes in local heat transfer, local surface pressure, total drag force, and base pressure with mass addition. The purpose is to compare induced pressure, total drag, and skin friction reduction calculations with the experimental data in order to evaluate the theoretical methods employed. Author

N66-19345*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

SUMMARY OF FULL-SCALE LIFT AND DRAG CHARACTERISTICS OF THE X-15 AIRPLANE

Edwin J. Saltzman and Darwin J. Garringer Washington, NASA, Mar. 1966 49 p refs

(NASA-TN-D-3343) CFSTI: HC $0.70/MF $0.50 CSCL 01A

Full-scale power-off flight lift and drag characteristics of the X-15 airplane are summarized for Mach numbers from 0.65 to 6.0 and for free-stream Reynolds numbers from 0.2×10^6 to 2.8×10^6 per foot. Comparisons are made between flight results and the wind-tunnel data that most nearly simulate the full-scale flight conditions. Analysis of the results shows that 95% of the maximum supersonic lift-drag ratio can be obtained over an angle-of-attack range from about 7° to 12°. The apparent effect of a sting support on the base pressure of an X-15 wind-tunnel model was propagated significantly beyond the fuselage base annulus. Wind-tunnel-model drag studies accurately predicted the full-scale zero-lift drag minus base drag of the X-15 at Mach numbers of 2.5 and 3.0. The trimmed drag-due-to-lift factor is 43% higher than the inverse of the

lift-curve slope $1/C_{L_\alpha}$ at a Mach number of 5. The major part of this difference represents the relatively large component of trim drag that accompanies the X-15 configuration.

Author

N66-19450*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

LINEAR AERODYNAMIC LOADS ON CONE-CYLINDERS AT MACH NUMBERS FROM 0.7 TO 2.0

Roger Lee Hamner and Alan D. Leff Washington, NASA, Mar. 1966 90 p refs Also published as LMSC/HREC-A710463, HREC/11289-1; see also Appendix B, LMSC/HREC-A710722, HREC/11289-1B

(Contract NAS8-11289)

(NASA-CR-413; LMSC/HREC-A710463; HREC/11289-1; LMSC/HREC-A710722; HREC/11289-1B) CFSTI: HC $3.00/MF $0.75 CSCL 01A

This study was conducted to establish aerodynamic loads for cone-cylinder configurations in the high subsonic, transonic, and low supersonic Mach number range. A series of force and pressure tests was conducted in a trisonic wind tunnel to complement data available from literature. By combining results from these tests with pertinent data from various references, experimental design curves were developed parametrically over a wide range of geometric and flow parameters. The solution presented is somewhat simplified, but can accurately predict loads for the majority of cases for cone-cylinders, and may serve as a basis for more refined analyses. R.N.A.

N66-19465*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EMPIRICAL METHOD FOR DETERMINING STATIC DISTRIBUTED AERODYNAMIC LOADS ON AXISYMMETRIC MULTISTAGE LAUNCH VEHICLES

Ralph J. Muraca Washington, NASA, Mar. 1966 109 p refs (NASA-TN-D-3283) CFSTI: HC $1.30/MF $0.75 CSCL 01A

This paper presents an empirical method for determining the distributed aerodynamic loads of arbitrary configurations in the linear angle-of-attack range. The method is based upon a compilation of wind-tunnel force and pressure data. Existing test results for geometric components such as cones, tangent ogives, spherical segments, cylinders, frustums, and boattails have been correlated and reduced to the form of generalized loading functions. These generalized loading functions cover a wide range of Mach numbers and geometric parameters and can be quickly applied to arbitrary configurations. Distributed aerodynamic coefficients for several configurations have been calculated by using the data presented herein, and these results are compared with the results obtained from wind-tunnel pressure tests of the specific configurations. Author

N66-19505# Royal Aircraft Establishment, Farnborough (England)

MEASUREMENTS OF PRESSURE DISTRIBUTION AND SHOCK-WAVE SHAPE ON POWER-LAW BODIES AT A MACH NUMBER OF 6.85

D. H. Peckham Apr. 1965 34 p refs

(RAE-TR-65075)

Experiments on a family of power-law body shapes, $y \propto x^n$, at a Mach number of 6.85 showed that for bodies of given fineness-ratio, minimum pressure drag is obtained at a value of the exponent n of about 0.7, the drag being approximately 20% less than that of a cone of the same fineness-ratio. Comparisons of the experimental pressure distributions with values calculated from approximate theories, strictly applicable only at $M_\infty = \infty$ and $\gamma \to 1$, were made. It was concluded that for low hypersonic Mach numbers ($M_\infty \simeq 7$) a more fundamental understanding of the flow field is required before reliable estimates of the pressure distributions on such body shapes can be obtained. Author

N66-19520*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AERODYNAMIC DAMPING AND OSCILLATORY STABILITY IN YAW AND PITCH FOR A MODEL OF A VARIABLE-SWEEP SUPERSONIC TRANSPORT AIRPLANE

Bruce R. Wright and Benjamin T. Averett Washington, NASA, Mar. 1966 22 p refs

(NASA-TM-X-1207) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Wind-tunnel measurements were made in the transonic pressure tunnel to determine the aerodynamic damping and oscillatory stability in yaw and pitch for a model of a variable-sweep supersonic transport airplane. All tests were made at an oscillation amplitude of 1° with the use of a forced-oscillation technique for angles of attack from −2° to 16°. The yaw tests were made at Mach numbers from 0.40 to 1.20 with corresponding Reynolds numbers, based on the mean aerodynamic chord of the fully swept wing, from 3.1×10^6 to 5.8×10^6. The pitch tests were made only at a Mach number of 0.80 at a Reynolds number of 5.0×10^6. For the model with the wing panels swept 25°, the yaw damping was positive and generally was linear with angle of attack at subsonic Mach numbers for the lower angles of attack. Both the damping and stability in yaw increased with increase in vertical-tail size. For a wing-sweep angle of 75° at the lower angles of attack, the damping and stability in yaw were positive and increased with vertical-tail size. Above about 6°, the yaw damping and stability parameters were very erratic and showed no systematic variations. Author

N66-19532*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.

PREDICTION OF THE INFLIGHT FLUCTUATING PRESSURES ON SPACE VEHICLES Summary Report, Jul. 1964–Sep. 1965

M. V. Lawson Dec. 1965 49 p refs

(Contract NAS8-11308)

(NASA-CR-71094; WR-65-26) CFSTI: HC $2.00/MF $0.50 CSCL 01A

This report presents a review of current data on the pressure fluctuations encountered by spacing vehicles during their ascent through the lower atmosphere. Complete data on these fluctuating pressure sources is not yet available, and much of the available data is fragmentary and inconsistent. However, the need for the prediction of these fluctuating pressures is very distinct and this report gives methods for this prediction based on currently available results. The sources considered include attached boundary layer turbulence, separated flow turbulence, oscillating shock waves, protuberance flows, jet impingement, cavity response phenomena, and base pressure fluctuations. Emphasis has been placed on separated flow and oscillating shock phenomena. Typical levels for each source are given as a function of vehicle Mach number, geometry, and total head. Frequency spectra and correlation areas are also given where possible. Author

N66-19534*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.

THE AERODYNAMICALLY INDUCED PRESSURE FLUCTUATIONS ON SPACE VEHICLES

M. V. Lowson 9 Oct. 1964 46 p refs
(Contract NAS8-11308)
(NASA-CR-71088; WR-64-5) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The major pressure fluctuations on a space vehicle will occur in the regions of separated flow and oscillating shocks. The transonic regime is best investigated by experiment, and the balance of the evidence is that the phenomena will be essentially random and governed by the geometry of the shoulders. In contrast, the supersonic regime may have discrete shock oscillation frequencies, and the separation regimes will be confined to the flare compression corners. The separation in the supersonic regime may be further divided into two classes characterized by the reattachment region being associated with a shock or an expansion fan. In the first class the separation length depends significantly on Reynolds No. and will therefore require some care in experimental studies. The separation in this case acts as a 17° fillet between flare and cylinder. In the second class attachment occurs at the top, expansion, corner and the position of this point dominates the flow pattern. The separation forms a region of approximately 12° in front of this point. This angle is dependent mainly on the ratio of step height to undisturbed boundary layer thickness. The mechanisms causing discrete frequencies may be divided into two classes, one depending on local conditions at the separation point and one depending on the whole flow
Author

N66-19592*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF GEOMETRIC MODIFICATIONS ON THE MAXIMUM LIFT-DRAG RATIOS OF SLENDER WING-BODY CONFIGURATIONS AT HYPERSONIC SPEEDS
William J. Small and Mitchel H. Bertram Washington, NASA, Mar. 1966 62 p refs
(NASA-TN-D-3276) CFSTI: HC $0.90/MF $0.75 CSCL 01A

An investigation was conducted at Mach numbers of 6.8 and 9.6 in an 11-inch hypersonic tunnel to determine the effects of geometric modifications and Reynolds number on the maximum lift-drag ratio of a series of slender wing-body configurations derived from high-maximum-lift-drag-ratio arrow-wing and delta-wing–body combinations. Most of the tests were conducted with models having 77.5° and 80.0° swept wings and 5° cone bodies. The basic configurations were altered by clipping the wing tips, removing portions of the wing-root areas, and adding a small half-cylindrical afterbody to several configurations. These modifications were intended to increase the volume–planform-area ratio of the vehicle with little sacrifice of the maximum lift-drag ratio. Results indicated that all modifications decreased the maximum lift-drag ratio much as would be expected from volume-area considerations; however, moderate amounts of the wing tip could be removed with little decrease of the maximum lift-drag ratio. For the basic models showing favorable flow interference benefits at a Mach number of 6.8 when the body was located beneath the wing, the favorable interference continued to occur throughout the series of geometric modifications.
Author

N66-19593*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF TWO BLUNTED CONE REENTRY CONFIGURATIONS AT MACH NUMBERS FROM 17.6 TO 22.2 INCLUDING SOME REYNOLDS NUMBER EFFECTS
Dal V. Maddalon Washington, NASA, Mar. 1966 33 p refs
(NASA-TN-D-3320) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The longitudinal aerodynamic characteristics of two reentry vehicles (a blunted cone and a blunted cylinder-cone) have been obtained at Mach numbers from 17.6 to 22.2 and Reynolds numbers (based on maximum body diameter) from 0.12×10^6 to 3.76×10^6. Contrary to results from a previous study on the blunted cylinder-cone configuration, the center-of-pressure location was found to be essentially independent of Reynolds number. In addition, the zero-angle-of-attack drag coefficient of the blunted cone reentry body was independent of Reynolds number whereas some viscous effects existed on the blunted cylinder-cone configuration. Author

N66-19659*# Rice Univ., Houston, Tex.
LIFT-TO-DRAG RATIOS OF SLENDER WINGS AT HYPERSONIC SPEEDS
Angelo Miele 1966 36 p refs
(Grant NGR-44-006-045)
(NASA-CR-70726; AAR-13) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, affine wing at hypersonic speeds is presented under the assumptions that the pressure distribution is Newtonian and the skin-friction coefficient is constant. Analytical expressions are derived relating the drag, the lift, and the lift-to-drag ratio to the geometry of the configuration. The class of flat-top wings whose upper surface is parallel to the free stream is considered. After it is assumed that the chordwise thickness distribution is a power law and the spanwise thickness distribution is proportional to some power of the chord distribution, the effect of the thickness ratio and the power law exponents of the lift-to-drag ratio is investigated. It is shown that a set of values of the thickness ratio and the power law exponents exists which yields a maximum lift-to-drag ratio. Specifically, the optimum thickness ratio is such that the friction drag is one-third of the total drag; the optimum chordwise power law exponent is one, meaning that a linear thickness distribution is the best in the chordwise sense; and the optimum spanwise power law exponent is one, meaning that a thickness distribution proportional to the chord distribution is the best in the spanwise sense. For a friction coefficient $C_f=10^{-3}$, the maximum attainable lift-to-drag ratio is 5.29.
Author

N66-19660*# Rice Univ., Houston, Tex.
ONE-DIMENSIONAL APPROACH TO THE MAXIMUM LIFT-TO-DRAG RATIO OF A SLENDER, FLAT-TOP, HYPERSONIC WING
Angelo Miele 1966 27 p refs
(Grant NGR-44-006-045)
(NASA-CR-70727; AAR-14) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, flat-top, affine wing at hypersonic speeds is presented under the assumptions that the pressure distribution is Newtonian and the skin-friction coefficient is constant. It is shown that a value of the thickness ratio exists such that the lift-to-drag ratio is a maximum; this particular value is such that the friction drag is one-third of the total drag. The subsequent optimization of the chordwise and spanwise contours is reduced to the extremization of products of powers of line integrals related to the lift, the pressure drag, and the skin-friction drag. For the chordwise contour, the variational approach shows that a linear thickness distribution is the best. For the spanwise contour, a thickness distribution proportional to the chord distribution is the best. The lift-to-drag ratio of the variational solution is independent of the chord distribution and depends on the friction coefficient only. For a friction coefficient $C_f=10^{-3}$, the maximum attainable lift-to-drag ratio is $E=5.29$.
Author

N66-19681*# Rice Univ., Houston, Tex.
TWO-DIMENSIONAL APPROACH TO THE MAXIMUM LIFT-TO-DRAG RATIO OF A SLENDER, FLAT-TOP, HYPERSONIC WING
Angelo Miele 1966 21 p refs
(Grant NGR-44-006-045)
(NASA-CR-70728; AAR-16) CFSTI: HC $1.00/MF $0.50 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, flat-top, wing at hypersonic speeds is presented under the assumptions that the planform shape is given, the pressure distribution is Newtonian, and the skin-friction coefficient is constant. The methods of the calculus of variations in two independent variables are employed. It is shown that the optimum wing has a constant chordwise slope so that the chordwise thickness distribution is a linear function of the distance from the leading edge and the trailing edge thickness distribution is proportional to the chord distribution. Also, the friction drag is one-third of the total drag. The lift-to-drag ratio and the thickness ratio of the variational solution are independent of the planform shape and depend on the friction coefficient only. For a friction coefficient $C_f = 10^{-3}$, the maximum attainable lift-to-drag ratio is $E = 5.29$ and the corresponding thickness ratio is $\tau = 0.126$. Author

N66-19682*# Rice Univ., Houston, Tex.
SIMILARITY LAWS FOR LIFTING WINGS OF MINIMUM DRAG AT HYPERSONIC SPEEDS
Angelo Miele 1966 30 p refs
(Grant NGR-44-006-045)
(NASA-CR-70729; AAR-16) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The problem of determining the chordwise and spanwise contours minimizing the drag of a flat-top wing in hypersonic flow is considered under the hypotheses that the pressure distribution is Newtonian and the skin-friction coefficient is constant. It is also assumed that the wing is slender and affine and that certain arbitrarily prescribed values are assigned to the lift, the planform area, the frontal area, the volume, the root chord, the span, and the root thickness. Two similarity laws are determined. Author

N66-19694*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SIMULATION INVESTIGATION OF THE LOADS EXPERIENCED BY A PILOTED LAUNCH VEHICLE
Robert K. Sleeper Washington, NASA, Mar. 1966 35 p refs
(NASA-TN-D-3298) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The loads incurred during first-stage piloted flight of a Saturn V type of launch vehicle encountering measured winds have been examined in a fixed-base planar simulation study. The study utilized nonlinear equations of motion with time-varying coefficients and included propellant sloshing dynamics and vehicle flexibility. Three forms of stability augmentation were provided the pilot and the resulting loads from each control mode were compared with the loads developed during control with an attitude–attitude-rate autopilot. The pilot was able to keep the load below that of the reference non-load-relieving autopilot except when rate augmentation was absent. Without rate augmentation, a significant increase in load was incurred. Author

N66-19718# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
AN ALGOL 60 PROGRAMME FOR THE CALCULATION OF AERODYNAMIC FORCES ON WINGS OSCILLATING HARMONICALLY IN SUBSONIC, COMPRESSIBLE FLOW USING LASCHKA'S METHOD
M. J. M. G. van Gennip and J. G. Wouters Oct. 1964 33 p refs
(NLR-TN-W.28) CFSTI: HC $2.00/MF $0.50

A universal program was developed for the calculation of aerodynamic forces using Laschka's theory. Because of the storage capacity of the computer in use the program has been splitup into three parts. The first and third parts are presented in this report in the form of an Algol program. Author

N66-19726*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION AT HIGH SUBSONIC SPEEDS TO DETERMINE STABILITY AND CONTROL CHARACTERISTICS OF ANTITANK MISSILES WITH RAM-PRESSURE JET CONTROLS ON A RING TAIL
Raymond D. Vogler Washington, NASA, Feb. 1960 68 p ref
(NASA-TM-X-192) CFSTI: HC $3.00/MF $0.75 CSCL 01A
(Declassified)

A wind-tunnel investigation was made at high subsonic speeds in the Langley high-speed 7- by 10-foot tunnel to determine the stability characteristics and the effectiveness of ram-pressure jet controls on three models of antitank missiles with ring tails. Tail size and position, body shape, ram-pressure ducts of various sizes, duct inlet positions, and slot exit areas were some of the factors involved in the investigation. The longitudinal stability and drag of the models were strongly influenced by interference between combinations of these geometric factors at different Mach numbers. Smaller ducts in the ring tail generally had more desirable drag and stability characteristics than larger ones, and ducts collecting air from inside the ring tail were more destabilizing than ducts collecting air from outside the ring tail. With the rear of the body faired to a boattail shape, a configuration with ducts collecting air from outside the ring tail was obtained that had stability and control through the Mach number and angle-of-attack range investigated. Author

N66-19727*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE SUBSONIC AND SUPERSONIC RELEASE CHARACTERISTICS OF AN EXTERNALLY CARRIED FUEL TANK FROM A 1/40-SCALE MODEL OF A BOMBER AIRPLANE
William F. Hinson Washington, NASA, Jan. 1961 142 p ref
(NASA-TM-X-354) CFSTI: HC $4.00/MF $1.00 CSCL 01A
(Declassified)

An investigation has been conducted to determine the release characteristics and flight behavior of a dynamically scaled, externally carried fuel tank when released at subsonic and supersonic free-stream Mach numbers of 0.69 to 0.92, 1.39, 1.59, 1.80, and 1.98. The results indicate that satisfactory releases can be obtained with the proper combination of canard-surface deflection and tail fins. The canard surfaces appeared to be ineffective when set at large negative deflections with the airplane model at a large positive angle of attack to the free stream. Decreasing the canard-surface deflection for a fixed wing angle of attack resulted in an increase in time to obtain a fixed pitch angle. As the wing angle of attack was increased with a constant canard-surface deflection, the time to obtain a fixed pitch angle was increased. Lateral translation did not appear to cause any unsatisfactory releases. Author

N66-19728*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECTS OF WING-TIP DROOP ON THE AERODYNAMIC CHARACTERISTICS OF A DELTA-WING AIRCRAFT AT SUPERSONIC SPEEDS

Richard H. Petersen Washington, NASA, May 1960 48 p refs

(NASA-TM-X-363) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Six-component force tests were conducted at Mach numbers of 3.0, 3.5, and 4.0 on a canard, delta-wing aircraft configuration to determine the effects of wing-tip droop on performance and stability. Wing-tip areas varying from 4 to 16 percent of the total wing area were drooped to angles up to 90° about streamwise hinge lines and hinge lines canted inward as much as 8°. The incremental changes in performance and stability due to the various forms of wing-tip droop are compared with estimates based on linearized theories. In general, drooping the wing tips of the test configuration resulted in forward shifts in the aerodynamic center, increases in directional stability, and decreases in the maximum lift-drag (untrimmed). Moderate, but significant, decreases in longitudinal stability and increases in directional stability were obtained in many cases with relatively small performance penalties. Author

N66-19729*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECTS OF BOUNDARY-LAYER REMOVAL THROUGH THROAT SLOTS ON THE INTERNAL PERFORMANCE OF A SIDE INLET AT MACH NUMBERS OF 2.0 AND 2.3

John J. Gawienowski Washington, NASA, Mar. 1961 29 p refs

(NASA-TM-X-502) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

A wind-tunnel investigation was conducted to determine the effects of varying the boundary-layer-control throat bleed slot width and mass-flow rate on the internal performance of a double-ramp external compression side inlet with a rapid turn. The tests were conducted at Mach numbers 2.0 and 2.3, and at Reynolds numbers from 2.2 to 2.4×10^6 per foot. Increasing the bleed slot area from 13 to 52 percent of the inlet area while maintaining an approximately constant bleed mass-flow rate resulted in a decrease in inlet maximum pressure recovery with a concomitant increase in distortion. Increasing the bleed mass-flow rate while maintaining a constant boundary-layer-control bleed slot size resulted in an increase in inlet maximum pressure recovery and a decrease in distortion. Significant changes occurred in critical mass-flow ratio as a result of the higher bleed flow rates through the larger slots. The inlet experienced larger performance losses at a Mach number of 2.3 than at 2.0 because of variations in both the bleed mass-flow ratio and slot width. Author

N66-19730*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF SEVERAL BLUNT BODIES TO DETERMINE TRANSONIC AERODYNAMIC CHARACTERISTICS INCLUDING EFFECTS OF SPINNING AND OF EXTENDIBLE AFTERBODY FLAPS AND SOME MEASUREMENTS OF UNSTEADY BASE PRESSURES

Lewis R. Fisher and Joseph R. Di Camillo Washington, NASA, Jan. 1959 35 p refs

(NASA-MEMO-1-21-59L) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Several blunt bodies having shapes that may be suitable for atmospheric reentry vehicles were tested to determine the aerodynamic characteristics of such shapes for angles of attack up to 34°. The tests were conducted through the transonic Mach number range. A full-skirted rather than a short-skirted type of shape developed the greatest amount of static stability and the largest lift-curve slopes. The angle of attack for maximum lift for such bodies appears to be subject to Mach number effects. Spinning a full-skirted body about its longitudinal axis generally increased the lift and reduced the pitching moment at angles of attack and reduced the aerodynamic static stability parameter through the transonic Mach number range. The extension of segmented clamshell-shaped flaps from the after body of a short-skirted model served to increase the lift and static stability only if the flaps extended into the airstream. Some evidence was found of oscillatory base pressures on two dissimilar shapes at certain high angles of attack and the highest Mach number in these tests. Author

N66-19732*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF THREE VERSIONS OF A SUPERSONIC AIRPLANE MODEL WITH A 45° SWEPT-BACK MIDWING AT MACH NUMBERS OF 1.57 AND 2.01

W. H. Appich, Jr., Waldo I. Oehman, and Donald T. Gregory Washington, NASA, Feb. 1959 121 p ref

(NASA-Memo-12-6-58L) CFSTI: HC $4.00/MF $1.00 CSCL 01A (Declassified)

An investigation has been conducted in the Langley Unitary Plan wind tunnel to determine the aerodynamic characteristics of a model of a 45° swept-wing, supersonic airplane. The directional stability of an enlarged-canopy configuration is markedly reduced in comparison with that of the basic model. A single ventral fin of the size used on these configurations is ineffective in overcoming directional instability at high angles of attack. Large nose strakes were the most effective means of increasing directional stability at high angles of attack at a Mach number of 2.01; however, the large-canopy configurations with large nose strakes were neutrally stable at angles of attack near 17°. Adding a center-line tank to the large-canopy configuration leads to a significant decrease in directional stability for all test conditions, and this configuration becomes directionally unstable near angles of attack of 10° and 6° at Mach numbers of 1.57 and 2.01, respectively. Author

N66-19735*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STATIC LATERAL-DIRECTIONAL STABILITY CHARACTERISTICS OF FIVE CONTEMPORARY AIRPLANE MODELS FROM WIND-TUNNEL TESTS AT HUGH SUBSONIC AND SUPERSONIC SPEEDS

Willard G. Smith and Louis H. Ball Washington, NASA, 4 Jan. 1956 98 p refs

(NACA-RM-A55J03) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

This report presents the static lateral-directional stability characteristics of several airplane models recently investigated which cover many of the geometric arrangements of high-speed airplane components. The measured aerodynamic qualities afford information on the aerodynamic derivatives required for calculation of airplane motions. The results are presented for a subsonic Mach number of 0.9 and for supersonic Mach numbers ranging from 1.2 to 1.9. The Reynolds numbers of the tests ranged from 1 to 4 million based on the mean aerodynamic chord. Discussion of the results is limited to the most pertinent aerodynamic phenomena contributing to the lateral-directional characteristics of each airplane type.

The directional stability of all the models deteriorated with increasing angle of attack and increasing Mach number. Interference effects are shown to have a strong influence upon the vertical-tail effectiveness and, consequently, upon the directional stability. These effects are, for the most part, associated with complex flow involving vorticity or shock waves. The data, however, serve to give some insight into the basic phenomena involved. Author

N66-19736*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AERODYNAMIC AND TRIM CHARACTERISTICS OF A MULTI-ENGINE DELTA-WING AIRPLANE MODEL

John M. Swihart and Willard E. Foss, Jr. Washington, NASA, 17 Feb. 1956 76 p refs

(NACA-RM-L55I27b) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

Three models of a delta wing airplane designed for a long range subsonic cruise and supersonic dash were investigated in the transonic tunnel. A two-engine version of the airplane was found to have a high transonic drag rise. The four-engine delta wing models were similar in all respects except one had a plane delta wing with full span elevons and the other had a cambered delta wing with partial span elevons. The results indicated that the four engine delta wing models had considerably lower transonic-drag-rise increments than the two engine model but did not achieve the low transonic-drag-rise increment of a similar idealized configuration. This was attributed to an auxiliary horizontal aerodynamic surface in close proximity to the wing and also to the effects of wing incidence, canopy, wing thickness ratio increase, landing gear fairings, afterbody shape, and cross section area distributions. The cambered wing models had higher values of maximum lift-drag ratio and lower drag coefficients than the plane wing models throughout the test Mach number range. E.A.O.

N66-19737*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SOME INTERFERENCE EFFECTS THAT INFLUENCE VERTICAL-TAIL LOADS AT SUPERSONIC SPEEDS

S. Sherman Edwards Washington, NASA, 17 Feb. 1956 20 p refs

(NACA-RM-A55430) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

Three types of aerodynamic interference originating from forward components of airplanes are shown to contribute to decreased vertical-tail effectiveness. The vorticity originating from a slender fuselage ahead of the wing resulted in a marked reduction in vertical-tail effectiveness with angle of attack for one model. For another design, location of the vertical tail in a region of reduced dynamic pressure associated with increased supersonic Mach numbers above the wing at angle of attack resulted in decreasing vertical-tail effectiveness with increasing angle of attack. In tests of a third model, pressure waves emanating from externally mounted engine nacelles caused a nonlinear variation of vertical-tail effectiveness with Mach number. Author

N66-19738*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF THE AIR-FLOW-REGULATION CHARACTERISTICS OF A TRANSLATING-SPIKE INLET WITH TWO OBLIQUE SHOCKS FROM MACH 1.6 TO 2.0

J. C. Nettles Washington, NASA, 24 Jul. 1956 20 p refs

(NACA-RM-E56D23b) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

The air-flow regulation and pressure recovery of a translating-cone inlet with a 15° initial conical half-angle and a 10° additional compression was investigated for a range of spike positions at Mach numbers of 0.6 and 1.6 to 2.0 at zero angle of attack. Performance at the 5° angle of attack was determined at a Mach number of 2.0. The pressure recovery of the two-shock inlet was essentially the same as the pressure recovery with a single 25° half-angle cone. For a given spike position the variation of critical equivalent air flow was small for a Mach number range of 1.6 to 2.0. Matching the inlet to a turbojet engine indicated that the required translation for the two-shock cone was greater than for a 25° cone. The subcritical stability of the two-shock inlet was improved over that of the single-shock inlet. For spike positions that placed the first oblique shock inside the cowl lip, the two-shock inlet displayed a pronounced hysteresis of the minimum stable point, which was not characteristic of the single-shock inlet. Author

N66-19739*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRESSURE DISTRIBUTIONS AT MACH NUMBERS OF 1.6 AND 1.9 OF A CONICALLY CAMBERED WING OF TRIANGULAR PLAN FORM WITH AND WITHOUT PYLON-MOUNTED ENGINE NACELLES

E. Ray Phelps Washington, NASA, 20 Apr. 1956 40 p refs

(NACA-RM-A56B03) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The results of an experimental investigation to determine the pressure-distribution characteristics of a conically cambered wing with and without pylon-mounted engine nacelles are presented for Mach numbers of 1.6 and 1.9. Wing airfoil sections in the streamwise direction were symmetrically distributed about a cambered surface conical about the wing apex. Pressure data are presented for nominal angles of attack of −2°, 0°, 4°, and 8° for a Reynolds number of 2.9 million for a Mach number of 1.6, and 2.6 million for a Mach number of 1.9. The data obtained indicate that the low-pressure region existing on the upper surface over the forward part of the wing was spread over a larger proportion of the local chord than would be the case for an uncambered wing. The addition of the engine nacelles beneath the wing created large pressure changes on the wing, particularly on the lower surface, which were reflected in the chordwise and spanwise distribution of load. These effects resulted in a net increase of lift carried by the wing. Author

N66-19740*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF DRAG AND STATIC LONGITUDINAL AND LATERAL STABILITY CHARACTERISTICS OF A MODEL OF A 40.4° SWEPT-WING AIRPLANE AT MACH NUMBERS OF 1.56 AND 2.06

Melvin M. Carmel and Kenneth L. Turner Washington, NASA, 18 Jan. 1957 128 p

(NACA-RM-L56I17a) CFSTI: HC $4.00/MF $1.00 CSCL 01A (Declassified)

A wind tunnel investigation has been conducted to determine the drag, longitudinal stability, and lateral stability characteristics of a model of a fighter-type airplane. During the program, several modifications were made to the model in an attempt to eliminate pitch-up. These data are included in this report. The tests were made at Mach numbers of 1.56 and 2.06 and at Reynolds numbers, based on the mean aerodynamic chord of the wing, of 1.225×10^6 and 1.026×10^6, respectively. Author

N66-19741*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC FLUTTER INVESTIGATION OF MODELS OF THE ALL-MOVABLE HORIZONTAL TAIL OF A FIGHTER AIRPLANE

Thomas B. Sellers Washington, NASA, 24 Jan. 1958 35 p refs

(NACA-TM-L57K13) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

A transonic flutter investigation of models of the all-movable horizontal tail of a fighter airplane has been conducted in a transonic blowdown tunnel. The models were dynamically and elastically scaled by criteria which provide a flutter safety margin. The results showed that the model had a stiffness margin which was insufficient to provide adequate safety from flutter at a Mach number of 1.06. An increase in the model pitch stiffness of approximately 40 percent of the anticipated design value resulted in an adequate margin. With the model pitch axis moved forward from 77 percent to 58 percent of the root chord, 83 percent of the anticipated design pitch stiffness was necessary to provide an adequate margin at sea level. Author

N66-19742*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEASUREMENT OF STATIC FORCES ON EXTERNALLY CARRIED BOMBS OF FINENESS RATIOS 7.1 AND 10.5 IN THE FLOW FIELD OF A SWEPT-WING FIGHTER-BOMBER CONFIGURATION AT A MACH NUMBER OF 1.6

Douglas J. Geier and Harry W. Carlson Washington, NASA, 31 Jan. 1957 194 p refs

(NACA-RM-L56K306) CFSTI: HC $5.00/MF $1.25 CSCL 01A (Declassified)

As a continuation of an extensive program to investigate interference and bomb-release problems, forces and moments have been measured at a Mach number of 1.6 in a 4 by 4 foot supersonic pressure tunnel on bombs of fineness ratios 7.0 and 10.5 in the presence of a swept-wing fighter-bomber airplane configuration for a large number of positions under the fuselage. The results can be used to calculate bomb-drop paths. The force results show that the wing has a large effect on the interference pattern of the bomb and that maximum moments occur when the bomb fins are in a region believed to be just within the wing flow field behind the leading-edge shock. Author

N66-19743*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SUMMARY OF THE LONGITUDINAL AND LATERAL STABILITY AND CONTROL CHARACTERISTICS OBTAINED FROM ROCKET-MODEL TESTS OF A SWEPT-WING FIGHTER-TYPE AIRPLANE AT MACH NUMBERS FROM 0.5 TO 1.9

Grady L. Mitcham Washington, NASA, 27 Feb. 1957 86 p refs

(NACA-RM-L56K19) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

The jet-engine simulator caused a decrease in trim angle of attack of approximately 1.27° and a decrease in trim-lift coefficient of 0.07. A positive increment in pressure coefficient was caused by the jet on the side and bottom of the fuselage. As the distance downstream of the jet exit increased, the increment on the bottom of the fuselage increased, whereas the increments on the side decreased to a negative peak. The drag rise begins at a Mach number of 0.90. The minimum-drag coefficient has a value of 0.02 at a Mach number of 0.87, and increases to a value of 0.074 at a Mach number of 1.83. There was a reduction in static longitudinal stability at the higher lift coefficients at subsonic speeds. Dynamic longitudinal stability was indicated throughout the speed range. The horizontal tail was an effective control throughout the speed range. The dihedral effect was adequate. The roll damping was nearly constant through the speed range and agreed with some theoretical values. The aeroelastic losses in rolling effectiveness varied from about 6 percent at 35,000 feet to about 84 percent at sea level. Author

N66-19744*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISON OF EXPERIMENTAL AND THEORETICAL ZERO-LIFT WAVE-DRAG RESULTS FOR VARIOUS WING-BODY-TAIL COMBINATIONS AT MACH NUMBERS UP TO 1.9

Robert B. Petersen Washington, NASA, 27 Mar. 1957 53 p refs

(NACA-RM-A56I07) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

Comparisons are made of experimental and theoretical zero-lift wave drag for several nose shapes, wing-body combinations, and models of current airplanes at Mach numbers up to 1.9. The experimental data were obtained from tests in the 6- by 6-foot supersonic wind tunnel and at the Wallops Island facility. The theoretical drag was found by use of a linear theory utilizing model area distributions. The agreement between theoretical and experimental zero-lift wave-drag coefficients was generally very good, especially for a fuselage or for fuselage-wing combinations that were vertically symmetrical. For other models that had rapid changes in body shape and/or were not vertically symmetrical, the agreement of theory with experiment ranged from fair to poor, depending on the severity of the change in shape. Author

N66-19745*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF CONICAL CAMBER FOR AN AIRPLANE CONFIGURATION HAVING A TRIANGULAR WING OF ASPECT RATIO 2.2

E. Ray Phelps and John W. Boyd Washington, NASA, 30 Apr. 1957 41 p refs

(NACA-RM-A57A10) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Five cambered wings tested were designed for a Mach number of 1.0. A plane wing was also tested for comparison. The lift, drag, and pitching moment were obtained for a Mach number range from 0.70 to 1.90 at a constant Reynolds number of 3.0 million and for angles of attack from −4° to +12°. Experimental results showed that a moderate amount of camber resulted in significant reductions of drag of the wing-body-tail combination at subsonic and transonic speeds; at low supersonic speeds, however, only small reductions of drag were realized. The use of greater amounts of camber produced large reductions in drag at lift coefficients above 0.20 for high subsonic and transonic speeds. At high supersonic speeds, however, the benefits of camber are considerably reduced and generally restricted to lift coefficients of 0.30 and above. Increase of the spanwise extent of the cambered area from 10 to 15 percent of the local semispan generally resulted in small reduction of the model drag for a design lift coefficient of 0.20. The lift and pitching moment were not significantly affected by the camber. Author

N66-19761*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
NUMERICAL PROCEDURES FOR ROLL STABILITY STUDIES
Philip J. Hays 13 Dec. 1965 42 p refs
(NASA-TM-X-53368) CFSTI: HC $2.00/MF $0.50 CSCL 01A

This report illustrates the numerical procedure used in performing roll stability analyses for Saturn type space vehicles. Vehicle control in the roll channel is provided by a position gyro and a rate gyro. The dynamics of the rate gyro are included as a separate equation in the equations of motion. The modes of oscillation in this system are (1) torsion, (2) roll, (3) roll sloshing, (4) rate gyro roll, and (5) swivel engine. Two methods are available for solving the system's eigenvalues: the matrix iteration method and the characteristic equation approach. In both cases the system is solved for the normalized eigenvectors, which provide additional information about the system. The frequency response of the system, at the control thrust vector point, can be found for a sinusoidal forcing function at various sensor locations. The equations of motion are derived in the appendix. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-18526# Frankford Arsenal, Philadelphia, Pa.
MATHEMATICAL SIMULATION OF HELICOPTER EMERGENCY EGRESS TRAJECTORIES Memorandum Report
Leonard A. De Stefano Nov. 1965 25 p ref
(M66-12-1; AD-625710) CFSTI: HC $1.00/MF $0.50

The basic equations of motion for a point mass under the influence of gravity, aerodynamic drag, and rocket forces are used to simulate a three-dimensional, three-degree of freedom, helicopter emergency egress trajectory. The resulting equations of motion were solved by a fourth order Runge Kutta method, programmed in Fortran for the Univac Solid State 90 digital computer. Included in this report is the computer program which was used to obtain a numerical solution to the equations of motion, the solution to three test cases, and a comparison with an experimental trajectory. Author (TAB)

N66-18556# Hiller Aircraft Corp., Palo Alto, Calif.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME V: STRUCTURAL ANALYSIS
Oct. 1965 127 p refs *Its* Hiller Eng. Rept.-64-65
(Contract DA-44-177-AMC-25(T))
(USAAVLABS-TR-64-68E; AD-625820) CFSTI: HC $4.00/MF $1.00

This report discusses stress calculations for major structural components of this system. Tip engine attachment hardware is also analyzed. Author (TAB)

N66-18563# Hiller Aircraft Corp., Palo Alto, Calif.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM, VOLUME I Summary Report
Oct. 1965 113 p refs *Its* Hiller Eng. Rept.-64-41
(Contract DA-44-177-AMC-25(T))
(USAAVLABS-TR-64-68A; AD-625818) CFSTI: HC $4.00/MF $0.75

The study of a tip-turbojet-powered rotor system for a heavy-lift helicopter, which is presented in thirteen volumes, is summarized. Included under this general subject are studies on parametric design, performance, structures and dynamics, wind tunnel, preliminary design, weight and balance, stability, and power plant. Author (TAB)

N66-18564# Hiller Aircraft Corp., Palo Alto, Calif.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME X: STABILITY AND CONTROL
Oct. 1965 89 p refs *Its* Hiller Eng. Rept.-64-50
(Contract DA-44-177-AMC-25(T))
(USAALVABS-TR-64-68J; AD-625822) CFSTI: HC $3.00/MF $0.75

The report discusses the results of a stability and control analysis of a large crane-type helicopter powered by a tip-mounted turbojet system. Specification MIL-H-8501A was used as a guide for criteria. Specification criteria were met; however, for improvements in handling qualities, a stability augmentation system is recommended. Author (TAB)

N66-19602*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.
FLIGHT MEASUREMENTS OF BOUNDARY-LAYER NOISE ON THE X-15
Thomas L. Lewis and Norman J. Mc Leod Washington, NASA, Mar. 1966 15 p refs
(NASA-TN-D-3364) CFSTI: HC $1.00/MF $0.50 CSCL 01C

Boundary-layer-noise data measured in flight with the X-15 airplane over a Mach number range from 1.0 to 5.4 and at altitudes from 45,000 feet to 105,000 feet are presented. The data were obtained at four locations on the airplane, selected to provide varied boundary-layer conditions. The highest recorded noise level was 150 decibels. Boundary-layer parameters were measured at one location and are used to present the noise data in a nondimensional form for comparison with data from flat-plate wind-tunnel studies by other experimenters. An appendix is included which illustrates the sensitivity of the microphones used to obtain the data as they are affected by altitude, vibration, and transient heating. Author

N66-19731*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EFFECT OF SEVERAL AFTERBODY MODIFICATIONS INCLUDING TERMINAL FAIRINGS ON THE DRAG OF A SINGLE-ENGINE FIGHTER MODEL WITH HOT-JET EXHAUST
John M. Swihart, Harry T. Norton, Jr., and James W. Schmeer Washington, NASA, Dec. 1958 51 p refs
(NASA-Memo-10-29-58L) CFSTI: HC $3.00/MF $0.50 CSCL 01C

An investigation of the drag characteristics of several boattailed afterbodies and afterbody terminal fairings has been conducted in the Langley 16-foot transonic tunnel utilizing a single-engine fighter model with a hot-jet exhaust. The tests were made over a Mach number range from 0.80 to 1.10 at jet total-pressure ratios up to 9. The results of the investigation indicate that the drag of these complex airplane configurations (without terminal fairings) follow the same trends as simple boattailed bodies of revolution; however, the interference effects of aerodynamic surfaces and protuberances can be large. It was also indicated that one type of afterbody terminal fairing which consisted of 8 bodies designed to improve the afterbody fineness ratio, to eliminate the excess base area, and to provide forward sloping surfaces for the underexpanded jet to act upon, reduced the drag below that of the best boattailed afterbody over most of the Mach number range of the investigation. Author

N66-19748# Stanford Research Inst., Menlo Park, Calif.
CORRELATION BETTEEN CLEAR-AIR TURBULENCE AND AIRCRAFT ELECTRICAL ACTIVITY Final Report, Oct. 1963–Aug. 1965
Joseph E. Nanevicz, Edward F. Vance, and Sidney M. Serebreny Oct. 1965 76 p refs
(Contract AF 19(628)-3308)
(AFCRL-65-614; AD-625309) CFSTI: HC $3.00/MF $0.75

The results of a cooperative effort by Stanford Research Institute, United Air Lines, and Air Force Cambridge Research Laboratories to determine the correlation between regions of clear-air turbulence (CAT) and aircraft electrical activity are described. Corona discharges from precipitation static dischargers on DC-8 aircraft were monitored and correlated with CAT encounters. A significant correlation was found to exist between CAT encounters and periods of electrical discharge. It is suggested that these electrical discharges may be caused by electric fields in the region of clear-air turbulence, particulate matter in the region that charges the aircraft, or a combination of both. A meteorological analysis was made of the regions where turbulence associated with electrical activity was observed. This analysis indicated that the CAT incidents were associated with jet streams. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-18500# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REMOTE STARTING DEVICES FOR GAS TURBINES
V. L. Borodkin, K. B. Sarantsev, and S. Z. Shabashov 15 Nov. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 166556 (Appl. no. 866641/24-6, 21 Nov. 1963) 2 p
(FTD-TT-65-1014/1+2+4; AD-625144) CFSTI: HC $1.00/MF $0.50

The invention includes a regulator for the feed valve, and end cutoff for the servomotor, and a slide valve. TAB

N66-18540# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PROTECTING THE WORKING SURFACE OF SOLAR BATTERIES
F. Kh. Nabiullin, Ye. M. Gertsik, and N. N. Gibadullin 30 Nov. 1965 4 p Transl. into ENGLISH from Soviet Patent no. 167263 (Appl. no. 855530/24-7, 5 Sep. 1963) 1 p
(FTD-TT-65-1142/1+4; AD-625186) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of protecting the working surface of solar batteries which contain photoelectric converters and concentrators. To eliminate damage from micrometric dust and particles of high energy the indicated converters are set up with the back surface to the light flux and concentrators are located in such a way that the light flux reflected from them falls on the active surface of the converters. Author (TAB)

N66-18561# Goodyear Aerospace Corp., Akron, Ohio.
DEVELOPMENT OF BALLUTE FOR RETARDATION OF ARCAS ROCKETSONDES Final Report, May 1964–Dec. 1965
John J. Graham, Jr. Dec. 1965 135 p refs
(Contract AF 19(628)-4194)
(AFCRL-65-877; AD-625785) CFSTI: HC $4.00/MF $1.00

A Ballute(A) retardation system for Arcas rocket-launched meteorological instruments was investigated. Various Ballute configurations were fabricated, tested, and evaluated in four states: airdock drop tests; low-altitude helicopter drop tests; high-altitude balloonborne drop tests; and rocket-launched flight tests at Cape Kennedy. The program culminated in three successful rocket-launched flights of the final configuration which, because of the high stability of the system, yielded telemetered temperature data of unprecedented quality. The Ballute system that meets the design goals of reliability, stability, descent rate, and cost will be made of fractional mil plastic film, will be about 16-1/2 ft in diameter, and will weigh about two pounds. Further development and system qualification testing are recommended prior to incorporation of the Ballute into the operational sounding system. Author (TAB)

N66-18562# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL Progress Report No. 2, 1 Feb.–31 May 1965
S.-Y. Lee, H. H. Richardson et al Sep. 1965 117 p refs Submitted for Publication
(Contract AF 33(615)-2210)
(AFFDL-TR-65-180; DSR-5393-2; AD-625729) CFSTI: HC $4.00/MF $0.75

The report presents technical results and describes progress in several phases of continuing applied research and development related to the design and development of high-performance fluid control devices for advanced aerospace systems. Emphasis continues to be placed on pneumatic components and systems which are capable of performing, with high reliability, over wide ranges of temperature and in the presence of intense radiation. The report describes current work dealing with a pulse length modulated gas servo, the dynamics of fluid jet modulators, fluid jet modulation by electric spark discharge, electrostatic fluid jet modulation, vortex valve characteristics, jet-pipe inlet coupling, the transmission characteristics of flexible fluid-carrying tubes, and a bi-fluid pneumatic transformer. Author (TAB)

N66-18622# Pratt and Whitney Aircraft, East Hartford, Conn.
SILENT, LIQUID HYDROCARBON–AIR FUEL CELL POWERPLANT. VOLUME I: TEXT Interim Technical Report, 18 Mar.–18 Sep. 1965
Stephen J. Keating, Jr. Oct. 1965 82 p
(Contract DA-44-009-AMC-967(T))
(PWA-2678; AD-626434) CFSTI: HC $3.00/MF $0.75

A preliminary reference design system consisting of a fuel cell module and a hydrogen generator was established and used to determine overall powerplant weight, volume and thermal efficiency. These are 410 lbs, 15 cu ft and 35.6% respectively. The reference design system also established the basic component characteristics from which system transient response capability may be determined during the next phase of the contract. Other studies were conducted to establish optimum system characteristics and operating parameters. The effects of reformer temperature, pressure and water-to-fuel ratio were studied. The effect of high altitude and ambient temperature and humidity on powerplant weight size and efficiency and on water recovery were analyzed and a start-up procedure established. Author (TAB)

N66-18650*# Electro-Optical Systems, Inc., Pasadena, Calif.
COMPARATIVE ANALYSIS OF SOLAR THERMIONIC AND PHOTOVOLTAIC SYSTEMS Final Report, Apr.–Sep. 1965
21 Oct. 1965 81 p Prepared for JPL
(Contracts NAS7-100; JPL-951066)
(NASA-CR-70836; EOS-6937-Final) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Power levels from 200 watts to 4 KW are examined in a variety of missions including solar and planetary probes, planetary orbiters and lunar stations. The power source, power conditioning, and battery storage subsystems are considered. Systems are compared on the basis of weight, area and reliability. This report summarizes the analysis performed during the contract. Detailed backup information is contained in a number of appendices. Author

N66-19025*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Fifth Quarterly Report, 21 Aug.–20 Nov. 1965
S. Naiditch [1965] 55 p
(Contract NAS7-326)
(NASA-CR-70841) CFSTI: HC $3.00/MF $0.50 CSCL 10C

The principal problems studied were: (1) stability of amalgam concentration cells, and (2) their equilibrium emfs relative to the state of the electrolytic solutions, i.e., liquid vs. gaseous. Obtained were stabilities, with respect to short-term fluctuations, of 0.1 microvolts for emfs of the order of 0.1 volt, or 1 ppm, and internal consistencies of the six combinations of the four electrodes of ±7 microvolts, or 70 ppm. It was concluded that the equilibrium emfs of concentration cells are independent of the state of the electrolytic solution. The emfs of four sodium amalgam concentration cells, using sodium iodide and sodium amide in ammonia electrolytes, with liquid or solid mercury amalgam electrodes, and filled under vacuum, were measured from as low as −20 to as high as 150°C. The electrical system was rewired and the cell preparation procedures were modified. In particular the parasitic currents on the amalgam surfaces were reduced by using ultrasonics to increase the uniformity of the amalgam electrodes. The stability now achieved is attributed to the removal of sources of bubbles and spurious emfs. All chemicals used in the cell were of high purity (NaI) or were further purified (Na, Hg, NG_3). The cells were baked out under vacuum to remove traces of volatilizable impurities. Experimental results are reported and discussed. Author

N66-19028# Pratt and Whitney Aircraft, East Hartford, Conn.
SILENT, LIQUID HYDROCARBON-AIR FUEL CELL POWERPLANT. VOLUME II: FIGURES AND TABLES Interim Technical Report, 18 Mar.–18 Sep. 1965
Stephen J. Keating, Jr. 8 Oct. 1965 91 p
(Contract DA-44-009-AMC-967(T))
(PWA-2678; AD-626435)

A compilation of data for a silent, liquid hydrocarbon–air fuel cell powerplant is presented. System schematics, design details, alternate component configurations, and performance parameters under various operating conditions are described. Included are low-recycle system data under various current loads; hydrogen generator performance; predicted cell performance; and the effects of ambient humidity and temperature, oxygen utilization, number of cell stacks, electrode area, power density, sound radiation patterns, and altitude. E.A.O.

N66-19040*# Wilmore Electronics Co., Inc., Durham, N. C.
DEVELOPMENT OF A 1.6-KW, 2000-VOLT, HIGH-FREQUENCY DC-DC CONVERTER FOR ION THRUSTORS USING A MODULATOR DESIGN AND AN INDUCTIVE ENERGY PUMPING TECHNIQUE FOR CONVERSION, REGULATION AND PROTECTION Summary Report
Edward T. Moore, Thomas G. Wilson, and Joseph N. Mc Intire 8 Dec. 1965 60 p refs
(Contract NAS3-6264)
(NASA-CR-54408) CFSTI: HC $3.00/MF $0.50 CSCL 10B

Primary objectives in the design of this modular converter were very low weight, high efficiency, and a ruggedness and general compatibility with the transient-inducing nature of the ion-engine load. High-frequency silicon power transistors were used with current-feedback base drive at a switching frequency of 10 kc. The use of special energy-storage power transformers was found to make possible a very efficient, lightweight, nondissipatively regulated converter which is physically very simple. These special transformers play an integral role in the voltage conversion, filtering, regulation, and protection functions which take place in the converter. Author

N66-19069# Harry Diamond Labs., Washington, D. C.
PROCEEDINGS OF THE FLUID AMPLIFICATION SYMPOSIUM, VOLUME III
Oct. 1965 340 p refs Symp. held 26–28 Oct. 1965
(AD-623457) CFSTI: HC $7.00/MF $1.75

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2. BISTABLE FLUID JET AMPLIFIER WITH LOW SENSITIVITY TO RECEIVER REVERSE FLOW W. S. Griffin (NASA Lewis Res. Center) p 17–35 refs (See N66-19528 09-03)

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16. A FLUID OPERATED DIESEL LOCOMOTIVE TRANSITION CONTROL UNIT C. H. Meyer (N. Y. Central R.R. Co.) and R. S. Gluskin (Univac, Blue Bell, Pa.) p 317-333 (See N66-19084 09-03)

17. AREA EXPERIENCE IN MODERATE VOLUME FABRICATION OF PURE FLUID DEVICES R. W. Van Tilburg (Corning Glass Works) p 335-349 (See N66-19085 09-03)

N66-19070 Societe Bertin et Cie, La Garenne-Colombes (France).

EXPERIMENTAL STUDY OF A PROPORTIONAL FLUID AMPLIFIER

Cyrille Pavlin *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 5-15 (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

An amplifier which applies the principle of the lever to aerodynamic jet deflection was designed and tested. The device yields good performances as a mass flow amplifier and provides facilities for matching impedances between stages. It can operate as a differential pressure sensor. Author

N66-19071 Corning Glass Works, N. Y.

DEVELOPMENT OF A PURE FLUID NORGATE AND A NORLOGIC BINARY TO DECIMAL CONVERTER

T. W. Bermel and W. R. Brown *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 37-61 refs (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

A review of the empirical approach to the design and fabrication of an active, two-input, pure fluid OR-NOR Gate is presented. Performance criteria and testing methods for this device are discussed relative to a discrete standard breadboard-type component. The breadboard assembly of a binary to decimal converter using these gates is reviewed and finally the reduction of this breadboard circuit to a three-dimensional circuit module is discussed. Author

N66-19073 Giannini Controls Corp., Malvern, Pa.

FLUID STATE HYBRID CONTROL SYSTEMS

P. A. Orner and J. N. Wilson (Saskatchewan Univ.) *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 93-106 refs Prepared jointly with Saskatchewan Univ. (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

This paper assesses the simultaneous use of both proportional and bistable fluid state devices in synthesizing closed loop control systems. In particular, the desirable features of systems using proportional devices in the power amplifier and actuator sections of the system and digital devices in the feedback and compensating sections are presented. The advantages of typical systems are evaluated with respect to accuracy, speed of response, compensation, stability, impedance matching, and efficiency. Preliminary experimental results are reported. Author

N66-19075 Harry Diamond Labs., Washington, D. C.

A DIGITAL-PROPORTIONAL FLUID AMPLIFIER FOR A MISSILE CONTROL SYSTEM

Carl J. Campagnuolo and Leonard M. Sieracki *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 131-159 refs (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

The following paper deals with the use of fluid amplification for amplifying small control signals emitted from a pneumatic gyroscope. A proportional flow gain of about 500 is achieved. The system produces a proportional output even though its components are digital in nature. It can be used in conjunction with pneumatic gyroscopes to control the pitch, yaw or roll of a missile. Within the atmosphere, the supply to the system can be rammed from the surrounding atmosphere. Author

N66-19076 Harry Diamond Labs., Washington, D.C.

A DEVELOPMENT REPORT ON A FLUID AMPLIFIER ATTITUDE CONTROL VALVE SYSTEM

Allen B. Holmes and John E. Foxwell *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 161-177 refs (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

Development of a digital hot gas fluid amplifier attitude control valve system is reported. The control system consists of a fluid amplifier reaction-jet valve, four solenoid actuators, a solid-propellant hot gas generator, and a regulated control air supply. The control hardware is packaged in a Test Instrumentation Missile (TIM) and is scheduled for flight testing at the Redstone Arsenal Missile Test Range in May 1965. This report describes the evaluation, design, and specifications of the hybrid fluid valving system that is to be employed in this flight test. Author

N66-19077 Harry Diamond Labs., Washington, D. C.

APPLICATION OF FLUERICS TO MISSILE ATTITUDE CONTROL

Carl J. Campagnuolo, John E. Foxwell, Allen B. Holmes, and Leonard M. Sieracki *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 179-201 refs (See N66-19269 09-03) CFSTI: HC $7.00/MF $1.75

This report describes the design, development, and evaluation of a control and thrust generating system consisting of an RC oscillator, a three-stage amplifier, and a supersonic single-stage power amplifier. These amplifiers were combined into a single four-stage fluid amplifier. The three-stage subsystem provides a modulated oscillatory control signal that enables the digital supersonic amplifier to deliver a proportional thrust output. The overall system has a power gain of 1×10^6 and a flow gain of 1.3×10^4 and delivers a maximum thrust of 70 pounds. M.R.W.

N66-19078 Bowles Engineering Corp., Silver Spring, Md.

A SECOND GENERATION OF FLUID SYSTEM APPLICATIONS

R. E. Bowles and E. M. Dexter *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 203-226 (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

(Contracts NOBS-88625; Nonr-4033(00); Now-65-0252-F; DA-44-177-AMC-202(T))

(R-7-23-65)

Five applications of pure fluid systems are reviewed: (1) a boiler control system; (2) a speed control; (3) a pressure discriminator for process control; (4) a course control for a torpedo; and (5) an automatic sequencing control system. For each of these the basic function of the control is described, and the striking features of each system are pointed out. Block diagrams, schematics, and photographs are included. M.R.W.

N66-19080 Harry Diamond Labs., Washington, D. C.
A TEMPERATURE CONTROL SYSTEM USING FLUERIC COMPONENTS
Richard N. Gottron and Wilmer Gaylord *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 245–265 refs (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

Presented is information on a recently developed pneumatic system having a pressure or flow output that is a function of the temperature of the gas in the sensing system. Laboratory tests from 21° to 120°C showed the d-c output level to be proportional to frequency over this range. The frequency, in turn, is proportional to the gas temperature. The differential output pressure change was about 150 millibars. Author

N66-19081 Sandia Corp., Albuquerque, N. Mex.
FLUID TIMER DEVELOPMENT
S. B. Martin and E. R. Phillips (Univac, Blue Bell, Pa.) *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 267–287 refs Prepared jointly with Univac Div. of Sperry Rand Corp., Blue Bell, Pa. (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

Reported is the development of a fluid timer of an integrated modular design which utilizes no tubing interconnections. Major functional modules are assembled to a combination manifold and base plate which contains all channels necessary to interconnect the modules. This feature makes possible a compact unit with efficient space utilization which is environmentally rugged. The timer is designed to operate from −65° to +165°F and to meet typical shock and vibration requirements. Photographs, block diagrams, and schematic drawings of the timer are shown. M.R.W.

N66-19082 Aviation Electric, Ltd., Montreal (Quebec).
THE USE OF A FLUID AMPLIFIER IN AN INTERMITTENT STREAM RELEASE VALVE FOR HIGH ALTITUDE RESEARCH
Tom Morton *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 289–307 ref (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

Presented is information on the design and performance of an intermittent stream valve incorporating a bistable fluid amplifier for modulating a stream of liquid ejected from a gun-launched high-altitude vehicle. The valve uses tri-methyl aluminum (TMA) as its working fluid and operates over a pressure range of 200 to 50 psig to deliver 35 puffs per minute at approximately 100 cc per puff. The adaptation of fluid amplifier techniques results in an intermittent valve which is lightweight, simple and extremely rugged. The valve is completely self-contained in that only the supply of the pressurized stream fluid is required to operate the valve. A sketch of the vehicle used to display the TMA trail is shown. M.R.W.

N66-19084 New York Central Railroad Co., N. Y.
A FLUID OPERATED DIESEL LOCOMOTIVE TRANSITION CONTROL UNIT
Charles H. Meyer and Richard S. Gluskin (Univac, Blue Bell, Pa.) *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 317–333 Prepared jointly with Univac Div. of Sperry Rand Co., Blue Bell, Pa. (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

The modern diesel railroad locomotive is essentially a mobile electric generating plant utilizing diesel fuel to produce direct-current power, which in turn energizes traction motors to turn the drive axles. Control of direction, speed and torque is accomplished by opening and closing electric relays and power contactors to apply current of the proper direction and magnitude to the traction motors. One of the most prevalent causes of delays, loss of power and reduced utilization of locomotives is control-circuit failures ranging from dirty or burned contacts to shock and vibration damage. Discussed in this report is the application of fluid logic to the traction motor control circuits in locomotives. Photographs, circuit diagrams, and schematics of the control unit are shown. M.R.W.

N66-19085 Corning Glass Works, N. Y.
AREA EXPERIENCE IN MODERATE VOLUME FABRICATION OF PURE FLUID DEVICES
R. W. Van Tilburg *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 335–349 (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

A discussion of the background of Fluid Amplifier development leads into the decisions on production organization. Specifications in their most phenomenal sense are covered and the logic behind the specifications is explained briefly. Production experience is summarized with facts on selections of specific devices produced to specific specifications. Conclusions indicate that Fluid Amplifiers have selection criteria similar to other control components. Other conclusions are drawn. Author

N66-19094*# Naval Ammunition Depot, Crane, Ind. Electrochemical Power Sources Branch.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TESTS OF GULTON INDUSTRIES 3.6 AND 5.6 AMPERE-HOUR NICKEL CADMIUM CELLS WITH VULCANIZED NEOPRENE TERMINAL SEALS
H. M. Schultz and E. C. Bruess, ed. 28 Jan. 1966 23 p refs (NASA Order W-11252-B)
(NASA-CR-70852; QE/C-66-69) CFSTI: HC $1.00/MF $0.50 CSCL 10C

Acceptance tests were conducted on 3.6 and 5.6 ampere-hour sealed nickel–cadmium secondary spacecraft cells with vulcanized neoprene terminal seals. The tests were performed at an ambient temperature between 23° and 27°C at existing relative humidity and atmospheric pressure, and consisted of the following: phenolphthalein leak test, capacity test, cell short test, immersion seal test, overcharge test, internal resistance test, and immersion seal test. The test procedures and results are discussed in detail, and tabulated and graphic data are included. From the test results it was concluded that the vulcanized neoprene seals of the cells are satisfactory as evidenced by no leakers out of the 72 cells tested. The weak point in the cell construction may be the cover-to-can weld as shown by two leakers out of all the cells tested. R.N.A.

N66-19134*# Harshaw Chemical Co., Cleveland, Ohio.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC FILM CELLS Third Quarterly Progress Report, 1 Dec. 1962–28 Feb. 1963
T. A. Griffin and J. C. Schaefer 23 Feb. 1963 26 p refs (Contract NAS3-2493)
(NASA-CR-70370) CFSTI: HC $2.00/MF $0.50 CSCL 10A

An evaporator was tooled for depositing uniform cadmium sulfide thin films on 36^2 in substrates. Several large area films were completed as front wall photovoltaic cells. Experiments showed that films evaporated at the standard substrate temperature of 220°C displayed the highest resistivity; also, films evaporated above 220°C displayed higher open circuit voltages. Measurements were initiated to determine the mechanism of apparent sheet resistance increase during lamination. Several problem areas are discussed, and their solutions are described. D.T.

N66-19135*# Geoscience, Ltd., La Jolla, Calif.
DYNAMIC ANALYSIS OF A LITHIUM-BOILING POTASSIUM REFRACTORY METAL RANKINE CYCLE POWER SYSTEM FOR THE JET PROPULSION LABORATORY
H. F. Poppendiek, C. M. Sabin, L. V. Feigenbutz, W. A. Morton, and D. A. Connelly Nov. 1965 133 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951198)
(NASA-CR-70371; GLR-39) CFSTI: HC $4.00/MF $1.00 CSCL 10B

A number of steady state and transient analyses of idealized models of the lithium-boiling potassium Rankine cycle space power system is presented. The unique aspects of liquid metal Rankine power systems are considered and simplified equations which define the nuclear reactor and power system components are given. Also, system simulation models and the governing equations are included. E.E.B.

N66-19171*# AiResearch Mfg. Co., Phoenix, Ariz.
DESIGN AND FABRICATION OF A HIGH-PERFORMANCE BRAYTON-CYCLE COMPRESSOR RESEARCH PACKAGE Final Report
May 1965 146 p
(Contract NAS3-2778)
(NASA-CR-54368; APS-5109-R) CFSTI: HC $4.00/MF $1.00 CSCL 10B

In this development program, advanced aerodynamic design procedures were used to design a high efficiency radial compressor for operation on monatomic gases. The compressor research package consists of a 6-inch diameter compressor wheel and shaft mounted on ball bearings and the associated mounting hardware. Following development testing, the final configuration was defined, and when the unit was tested on argon, efficiencies in excess of 0.80 total-to-total were obtained. Additional testing is to be accomplished by the NASA. Author

N66-19252# Naval Research Lab., Washington, D. C.
RADIATION DAMAGE IN SILICON SOLAR CELLS FROM 4.6-MeV PROTON BOMBARDMENT
K. S. Statler 15 Nov. 1965 45 p refs
(NRL-6333; AD-625440) CFSTI: HC $2.00/MF $0.50

A study was made of the radiation damage in ten types of silicon solar cells as a result of 4.6-Mev proton bombardment. The cells comprised such types as p/n cells, n/p cells with different bulk-resistivities, planar cells, and drift-field cells. A comparative analysis was made of the radiation-induced degradation in these cells as a function of short-circuit current, maximum power output, minority-carrier diffusion length, and photovoltaic spectral response. The p/n cells were found to be more sensitive to radiation damage than any type of n/p cell in this study. In the n/p cells, there is a definite trend toward increasing radiation resistance accompanying increasing values of bulk resistivity, up to 10 ohm-cm. The drift-field solar cells exhibit a further improvement in radiation resistance beyond that of the other types of n/p cells. Author (TAB)

N66-19482*# Thermo Electron Engineering Corp., Waltham, Mass.
SURFACE AND ADSORBATE STUDIES Final Report, 25 Mar. 1963-25 Mar. 1964
S. S. Kitrilakis, D. Lieb, L. van Someren, and J. H. Weinstein [1964] 218 p refs
(Contract NAS3-2539)
(NASA-CR-54327; TE-19-65) CFSTI: HC $6.00/MF $1.25 CSCL 10A

The adsorption of Cs and CsF on refractory metal surfaces has been studied using a new emission scanning device. Experimental results are presented in the form of thermionic emission display photographs and point by point work function measurements. A definite correlation is shown to exist between crystal orientation and emission properties. The effect of CsF is to shift the minimum value of work function to lower surface to reservoir temperature radio values. In transient tests, exceptionally low collector work function values were obtained. Author

N66-19526*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BISTABLE FLUID JET AMPLIFIER WITH LOW SENSITIVITY TO RECEIVER REVERSE FLOW
William S. Griffin Washington, NASA, 1965 20 p refs Presented at the 3d Fluid Amplification Symp., sponsored by the Army Materiel Command, Washington, D. C., 26-28 Oct. 1965
(NASA-TM-X-52120) CFSTI: HC $1.00/MF $0.50 CSCL 13G

A selected bistable fluid jet amplifier is presented which exhibits low receiver-interaction region coupling and which also has reasonable receiver power recoveries and control signal pressures and flows. The receivers are specifically designed to handle load reverse flow such as might be delivered by a piston. If the control signal pressure is increased approximately 50 percent above that necessary to switch the power jet into an unblocked receiver, the jet may be switched into a receiver pressurized at 40 percent of supply. Author

N66-19558# Engelhard Industries, Inc., East Newark, N. J. Research and Development Div.
FUEL CELL CATALYSTS Quarterly Report No. 1 May 1-Jul. 31, 1965
O. J. Adlhart and A. J. Hartner [1965] 52 p refs
(Contract DA-28-043-AMC-01286(E))
(Rept.-1; AD-625127) CFSTI: HC $3.00/MF $0.50

A mathematical analysis of mass transport to the catalyst pore walls was performed indicating wide and short pores being the desirable geometric configuration. The optimum numerical values of length and radius are dependent on the diffusivity and the reaction rate constant. A series of low porosity carbon carriers and fine grid boron carbide samples were investigated for the support of platinum and platinum-ruthenium alloys. Owing to a defect surface structure boron carbide provides a better dispersion of platinum than obtainable with carbon. The crystallite size of platinum-ruthenium alloys on the other hand appears to be primarily dependent on the ruthenium content and less affected by the supporting surface. The performance of catalysts for the oxidation of methanol and propane does not necessarily correlate with the degree of metal dispersion indicated by the crystallite size. The ultimate performance of the catalyst is significantly affected by the porosity of the carrier and the shape and size of the catalyst particles. Performance declines considerably with increasing porosity of the carrier, particularly with propane. Carriers of very small particle size are undesirable as they adversely affect the porosity of the catalyst layer on the electrode. Author (TAB)

N66-19596*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GENERATOR WITH A SUPERCONDUCTING MAGNETIC FIELD FOR USE IN 1-MEGAWATT SPACE POWER SYSTEMS
Dale W. Cooper and Perry W. Kuhns Washington, NASA, Mar. 1966 52 p refs
(NASA-TN-D-3345) CFSTI: HC $3.00/MF $0.50 CSCL 10A

A space turboelectric generation system delivering 5000 volts, direct current, at a 1-megawatt power level is analyzed. This system employs a superconducting field as the stator with a 200° or 340°K rotor as the armature. Both alternating- and direct-current models of this generator are studied for possible spacecraft use. A comparison with other rotating generation systems that might be used as alternatives shows that the superconducting magnetic generator system holds promise of being lighter in weight and more efficient. Consideration is given to the effects of refrigeration system weight and to the seal, bearing, and electric-contact problems in space. A parametric analysis of various rotating generator types is also made. Author

N66-19607*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP D TE-M-458 RETROMOTOR AND IGNITER SAFETY AND HANDLING PLAN
E. W. Travis 4 Jan. 1966 28 p
(NASA-TM-X-55419; X-723-66-28) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The anchored interplanetary monitoring platform (AIMP) spacecraft utilizes a 78.63 lb retro motor for lunar orbit insertion. Due to the potentially hazardous nature of the handling, checkout and integration of the motor into the spacecraft, certain operational precautions and design safety features have been adapted. This document describes the retro motor and igniters, and lists the precautions that will be taken during spacecraft buildup at the launch site to reduce the potentially hazardous conditions to safe and acceptable levels. Author

N66-19612*# National Aeronautics and Space Administration, Washington, D. C.
AN INTRODUCTION TO FUEL CELLS
Ernst M. Cohn [1965] 16 p refs
(NASA-TM-X-57300) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Fuel cells are defined, and the distinction between fuel cells and other electrochemical systems is discussed. A table shows the classification of fuel cells, and their industrial potential is given. H.S.W.

N66-19654*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATIONS TECHNOLOGY SATELLITE GRAVITY GRADIENT STABILIZATION SYSTEM Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1965
20 Jan. 1966 192 p *Its* Doc.-66SD4201
(Contract NAS5-9042)
(NASA-CR-71188) CFSTI: HC $5.00/MF $1.25 CSCL 22C

Progress is reported in the design and development of gravity gradient stabilization systems for the Applications Technology satellites. Detailed discussions are given in the following areas: systems analysis and integration, boom subsystem, combination passive damper, attitude sensor system, ground testing, quality control, materials and processes, manufacturing, and reliability. Various photographs, charts, graphs, tables, and schematics are included. C.T.C.

N66-19706*# Atomics International, Canoga Park, Calif.
RADIATION EFFECTS ON SILVER AND ZINC BATTERY ELECTRODES, II Interim Report, Jul.–Oct. 1965
G. R. Argue, H. L. Recht, and W. A. Mc Colum [1965] 36 p refs Prepared for JPL
(Contracts NSA7-100; JPL-951109)
(NASA-CR-71256; AI-65-264) CFSTI: HC $2.00/MF $0.50 CSCL 10C

The study of the effects of radiation on silver and zinc electrodes was continued with specific attention being given to the silver electrode. Cadmium counter electrodes were used with the silver electrodes in the study pending the availability of suitable zinc electrodes. Material losses from irradiated (7.2×10^7 rads) silver electrodes of 3.0 gm total weight averaged 60.2, 77.7 and 52.9 mg at 90, 60 and 30% state of charge, respectively; the corresponding losses for the control silver electrodes were 11.9, 22.7 and 22.4 mg. The predominant silver species detected in the precipitated material from the irradiated cells was silver metal. The effects of radiation on electrode capacity appear to be no larger than 5 to 10% in the dose range studied ($\approx 10^8$ rad (H_2O)); both capacity increases (at 90% and 60% state of charge) and decreases (at 30% state of charge) were observed. Considerable scatter was observed in the silver electrode capacity data. Hydrogen evolution occurred during cell irradiation; none was formed in the control cell. A pressure build-up was observed in irradiated cells; the control cells showed both small increases and decreases in pressure. Author

N66-19711*# TRW Systems, Redondo Beach, Calif.
STUDY AND ANALYSIS OF SATELLITE POWER SYSTEMS CONFIGURATIONS FOR MAXIMUM UTILIZATION OF POWER Third Quarterly Progress Report, 19 Nov. 1965–18 Feb. 1966
W. G. Binckley [1966] 36 p
(Contract NAS5-9178)
(NASA-CR-71251; E-7061.2-225) CFSTI: HC $2.00/MF $0.50 CSCL 10B

The converter parametric data previously presented were expanded so that the efficiency and weight performance of the individual sections can be identified separately. This will allow tradeoffs to be made between a single converter which provides the functions of a regulator, inverter, and TR units, and discrete equipment, such as a regulator, inverter, and TR units. Also, various types of regulators and their parametric data were reviewed for the specific application of battery charge or discharge control. To clarify the usefulness and applicability of the parametric data for the dc to dc converter, the power, frequency, weight, and efficiency of existing hardware were compared with the parametric data previously reported. E.E.B.

N66-19778# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BELLOWS-TYPE DEVICE FOR HYDRAULIC REMOTE CONTROL OF AN ACTUATOR
I. S. Timofeyev 8 Dec. 1965 10 p Transl. into ENGLISH from Soviet Patent no. 163047 (Appl. no 783644/25-8, 21 Jun. 1962) 3 p
(FTD-TT-65-1129/1+2+4; AD-625184) CFSTI: HC $1.00/MF $0.50

A device of the bellows type for remote hydraulic control of an actuating mechanism with micrometric adjusting consisting of a pickup with control lever and a receiver with an actuating lever is described. To eliminate temperature errors each pickup and receiver consists of two bellows fastened in a stock with a toothed rack which engages with a pinion set on the axis of the control lever or the actuating lever. Each bellows of the pickup is connected by tubing with one of the bellows of the receiver forming a closed cavity. TAB

N66-19779# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIMENSIONLESS CHARACTERISTICS OF GAS TURBINE UNITS WITH SLITTED SHAFTS

V. A. Robova and Reng-Yung Tu 26 Oct. 1965 16 p Transl. into ENGLISH from Energomashinostr. (Moscow), no. 8, 1963 p 14–17
(FTD-TT-65-671/1+2+4; AD-625182) CFSTI: HC $1.00/MF $0.50

Results of designing a gas turbine unit with a slitted shaft at a variable regime and in relative units are presented. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-18516# Army Foreign Science and Technology Center, Washington, D. C.

THE ROLE OF ELECTROMAGNETIC FIELDS IN PHYSIOLOGICAL PROCESSES

A. S. Presman Dec. 1965 9 p refs Transl. into ENGLISH from Biofizika (Moscow), no. 1, 1964 p 131–134
(FSTC-381-T65-601; AD-625857) CFSTI: HC $1.00/MF $0.50

An attempt is made to analyze certain data on the specific effect of electromagnetic fields on the nervous system, tissue growth and development, on the state of protein molecules, and on the generation of electromagnetic fields in the tissues of living organisms. TAB

N66-18702# European Atomic Energy Community, Brussels (Belgium).

THE FEASIBILITY OF A NEW PROCEDURE FOR BIOLOGICAL DOSIMETRY

J. F. Whitfield, S. Kellerer, H. Brohee, and T. Youdale 1965 34 p refs
(EUR-2505.e)

The proportion of rat, as well as human, lymphocytes with structureless (or pycnotic) nuclei can serve as a sensitive indicator of absorbed radiation dose (following an acute exposure) provided that the irradiated cells are removed from the blood and maintained in a glucose-phosphate medium. The dosimeter is particularly sensitive to doses between 0 and 100 R. Above 100 R, the slope of the linear dose-effect curve tends to decrease and the dosimeter becomes less sensitive. Author (NSA)

N66-18716# Long Island Jewish Hospital, New Hyde Park, N. Y. Dept. of Labs.

BIOELECTRIC EFFECTS IN CALCIFIED TISSUES Progress Report, 1 Sep. 1964–Jun. 1965

Leroy S. Lavine and Peter Rogatz Jun. 1965 11 p refs
(Contract AT(30-1)-3282)
(NYO-3282-1) CFSTI: HC $1.00/MF $0.50

Progress is reported in the development of methods and equipment for use in making piezoelectric measurements in bone and other materials. Preliminary results indicate that the piezoelectric effect may not be confined to calcified tissues but may be a general property of practically all tissue and may play a vital role as the initiating mechanism in tactile responses. Data are included from piezoelectric measurements on bone, tendon, ivory, and bamboo. A technique was developed for studying the uptake and deposition of ^{45}Ca by clams while portions of their shells are under local stress. NSA

N66-18727# Howard Univ., Washington, D. C. Dept. of Biochemistry.

CHEMICAL EFFECTS OF IONIZING RADIATIONS ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES Progress Report

Felix Friedberg 15 Oct. 1965 9 p refs
(Contract AT(30-1)-2735)
(TID-22291) CFSTI: HC $1.00/MF $0.50

Results are reported from studies that show definite indications for structural unfolding of the ribonuclease molecule upon gamma irradiation in the solid state (increase in viscosity and increase in negative optical rotation) concommitant with the loss in enzymatic activity. Disulfide interchange does not occur to any appreciable extent. The data establish that the number average molecular weight of the enzyme is not changed by the irradiation. Author (NSA)

N66-18734# Hanford Atomic Products Operation, Richland, Wash.

FAST NEUTRON EFFECTS ON PRODUCTIVITY OF YOUNG AND OLD FLOUR BEETLES, TRIBOLIUM CASTANEUM HERBST AND ALTERATIONS DUE TO TEMPERATURE AND SEX-EXPOSED

Howard E. Erdman 6 Oct. 1964 16 p refs
(Contract AT(45-1)-1350)
(HW-SA-3537) CFSTI: HC $1.00/MF $0.50

Virgin day-old and three-week old flour beetles, *Tribolium castaneum*, strain Brazil CI, were given approximately 830 and 970 rads, respectively, of fast neutrons of average energy 4.6 Mev. Ten replicates of the mating combinations control, male-exposed, female-exposed, and both-exposed were cultured at 25°C, 29°C and 32°C in 65 to 70% relative humidity. Productivity, measured as adult progeny per reproducing female per day, was scored for 14 days. Decreases in temperature progressively delayed reproductive onset. Additional delay in reproductive onset occurred when young female beetles were irradiated, indicating a greater radiation sensitivity at this stage of oogonial maturation. Thereafter, no other indication of a differential radiosensitivity of germ cells was noted. Productivity of young beetles plateaued during the second week; that of old beetles after the first day. Male- and female-exposed productivities were not significantly different within a temperature but were less than control and greater than both-exposed. Neutron irradiation effects appeared additive in that both-exposed mating combinations had the expected number of progeny compared to those in which one sex only was exposed. Author (NSA)

N66-18737# Padua Univ. (Italy). Inst. of Zoology and Comparative Anatomy.

A QUANTITATIVE EVALUATION OF CELL SURVIVAL AS A FUNCTION OF RADIATION DOSE Final Report, 1959–1962

G. Colombo, A. G. Levis, and G. Marin [1962] 74 p refs
(Contract IAEA-38)
(NP-15149)

Results are reported from a series of studies on the effects of X-radiation on multiplication of guinea pig kidney cells in tissue culture. The effects of doses ranging from 150 to 900 R on growth rate, cell morphology, and survival were studied under various environmental conditions. Results indicated that radiation caused a general depression of mitotic activity and temporarily blocks cells entering mitosis; the radiosensitivity of cells was changed only by extreme changes in environmental conditions; the presence of giant cells appeared to be a morphological expression of lethal damage carried by the clones; and specific genetic loci appear to control radiosensitivity. A comparison was made of the effects

of nitrogen mustard and X radiation on growth and morphology of cells in tissue culture. Results indicate that X radiation and nitrogen mustard do not act on a common target in causing reproductive death of cells. A nitrogen mustard-resistant strain of cells was developed and chromosome studies and studies of colony formation after X irradiation indicated no cross-resistance to X radiation in the cells. A list is included of 17 publications that report results of the series. NSA

N66-18741# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.

THE LIPIDS OF RUVETTUS PRETIOSUS MUSCLE AND LIVER

Judd C. Nevenzel, Waldtraut Rodegker, and James F. Mead [1964] 19 p refs

(Contract AT(04-1)-Gen-12)

(UCLA-12-534) CFSTI: HC $1.00/MF $0.50

The muscle of the gempylid fish, *Ruvettus pretiosus*, contains 14.7% (wet weight) of lipid, which is predominantly wax esters of 34 and 36 carbon atoms with one and two double bonds. The liver lipids contain only about 2% wax esters. Contrary to a previous report, the muscle lipid does not contain hydroxy fatty acids. Gas-liquid chromatographic analyses are reported for the fatty acids of several lipid fractions, including the muscle wax esters, for the long-chain alcohols of the muscle wax esters, and for the unhydrolyzed wax esters.

Author (NSA)

N66-18753# Los Alamos Scientific Lab., N. Mex. Biomedical Research Group.

SYNCHRONIZED MAMMALIAN CELLS. II: AN EXPERIMENTAL TEST OF A MODEL FOR SYNCHRONY DECAY

E. C. Anderson and D. F. Petersen [1964] 7 p refs

(Contract W-7405-ENG-36)

(LA-DC-6507) CFSTI: HC $1.00/MF $0.50

A theoretical model is described which can be used to make quantitative predictions for the decay of synchrony in cell cultures on the basis of the assumption that decay is due to a random variability in generation times. A method of obtaining data of sufficient precision to permit accurate analysis of growth rate patterns is described. This was applied in a test of the model and the comparison of the single and double block methods for the induction of synchrony. Chinese hamster ovary cells were grown in tissue culture, synchronized by the thymidine block method, and total cell concentrations were measured at hourly intervals by electronic particle counting. A comparison was made of experimental data and theoretical decay predicted by the model. NSA

N66-18767# Atomic Energy Commission, Washington, D. C. Div. of Biology and Medicine.

TERRESTRIAL AND FRESHWATER RADIOECOLOGY A Selected Bibliography (Supplement 3)

Alfred W. Klement, Jr. and Vincent Schultz Feb. 1965 119 p refs

(TID-3910, Suppl. 3) CFSTI: HC $2.50/MF $0.75

A list is presented of 1207 publications in the field of radioecology, including the biological aspects of radioactive fallout, waste disposal, terrestrial radioecology, and freshwater radioecology. An attempt was made to reference publications related to the field or laboratory studies of wild species of plants and animals with respect to radiation effects or metabolic studies involving radionuclides. Complete information concerning reference sources and brief content notes are included. NSA

N66-18794# Institute of Public Health, Tokyo (Japan). Dept. of Radiological Health.

DISTRIBUTION STUDIES OF COMMON AND RADIOACTIVE CESIUM IN NATURE AND IN MAN Final Report, 1 Apr. 1962–31 Mar. 1965

Noboru Yamagata 31 Mar. 1965 18 p refs

(Contracts IAEA-140/RB; IAEA-140/RI/RB; IAEA-140/R2/RB) (NP-15179)

The relation between the content of stable Cs and ^{137}Cs in blood and the whole-body was determined by parallel measurements of Cs and ^{137}Cs in whole-body and blood made on human subjects at monthly intervals. Cesium was determined in whole blood after neutron activation. Relatively small monthly fluctuations were found in whole-body values but blood values showed considerable monthly fluctuations. Results suggested the validity of employing a factor of 6 in relating whole-body to blood concentrations in a quasi-equilibrium state between the diet and whole-body content of ^{137}Cs. Comparison of data with measurements of ^{137}Cs content in blood samples obtained from blood banks throughout Japan indicated there may be a slight geographical variation. The data also indicated that women have less Cs in their blood than men have. On the assumption of the Japanese standard man having a body weight of 56 kg, of which one-third by weight is total blood, the whole-body blood Cs content was calculated as 9 μg. The whole-body content of Cs was calculated to be 1.1 mg. Thus 0.8% of the whole-body Cs is in blood. This finding can be applied in the assessment of the whole-body content of ^{137}Cs by analysis of blood. It is concluded that whole-blood analysis for ^{137}Cs may be valuable where whole-body counters are not available. Twenty samples of human rib bone were analyzed for stable Sr and Ca content. The results showed 124 ppm of Sr and 37.3 of Ca on the average, based on ash weight. The Sr/Ca ratio was found to be 3.3×10^{-4}. Rice samples collected throughout Japan were analyzed for Sr and Ca content. The results showed a considerably higher Sr content in polished rice than in unpolished brown rice. The discrimination ratio of Sr/Ca from polished rice to human bone was calculated as 0.13 and from brown rice to human bone as 0.22. The discrimination factor from diet to bone in Japan is 0.17. Mechanisms of the distribution of ^{137}Cs and stable Cs in nature and the role of food chains in the incorporation of ^{137}Cs in man are discussed. Standard diets in Japan and in the U. S. are compared as to content of stable Cs, Mn, and Fe. It is concluded that the radiological protection of a population should be planned on the basis of dietary differences. NSA

N66-18795# Yale Univ., New Haven, Conn.

THE EFFECTS OF RADIATIONS ON BIOLOGICAL MOLECULES AND ON CELLS IN TISSUE CULTURE Progress Report

[1965] 18 p refs

(Contract AT(30-1)-2653)

(TID-22128) CFSTI: HC $1.00/MF $0.50

Progress is reported in studies on the electron spin resonance spectra of X irradiated DNA; the radiosensitivity of mammalian cells in tissue culture, with emphasis on high LET radiations such as accelerated He, Li, B, and C ions, and the identification of a strain of *Bacillus subtilis* DNA that has an uneven distribution of thymine in the two complementary strands. A list is included of papers published during the period covered by this report. NSA

N66-18807# California Univ., Berkeley. Lawrence Radiation Lab.

BIO-ORGANIC CHEMISTRY Annual Report, Dec. 1963–Dec. 1964

9 Feb. 1965 36 p refs
(Contract W-7405-ENG-48)
(UCRL-11948) CFSTI: HC $2.00/MF $0.50

Progress is reported in studies of the photosynthesis of carbon compounds; the biosynthesis of opium and tobacco alkaloids; the structure and chemistry of chloroplasts; problems in biological organization and regulation; the physical chemistry of biological systems; the optical properties of biopolymers; the fate of the radical initiator in the radiolysis of crystalline choline chloride; the origin of biohydrocarbons from a one-billion-year-old sediment; the role of cyanamide in chemical evolution; the photochemistry and radiation chemistry of thymine; biochemical and anatomical changes in the brain of rats induced by experience or environment; and the mechanism of D_2O-induced sterility in mice. Many of the studies involved the interaction of radiation with both chemical and biological systems as well as the use of tracer methods to define the nature of the interactions. A list is included of 39 publications during the period covered by this report. NSA

N66-18830# Union Carbide Nuclear Co., Oak Ridge, Tenn.
Y-12 RADIATION SAFETY MANUAL
P. C. Mc Ree, C. M. West, and J. D. Mc Lendon, ed. 11 May 1965 115 p refs
(Contract W-7405-ENG-26)
(Y-1401, Rev.) CFSTI: HC $4.00/MF $1.00

Procedures and equipment are described that are used for the protection of personnel from exposure to ionizing radiation and radioactive materials, industrial toxicants, and other environmental factors that may cause sickness, impair health and well-being, or cause inefficiency among plant workers. Radiation protection guides for exposure to external or internal radiation are set out, and criteria for environmental and personnel monitoring programs are presented. Equipment described includes a personnel decontamination facility and whole-body radiation counter. NSA

N66-18838# Pavia Univ. (Italy). Inst. of Genetics.
INVESTIGATIONS OF MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY
R. E. Scossiroli 1 Jan. 1965 57 p refs
(Contract IAEA-61/US)
(TID-21649) CFSTI: HC $3.00/MF $1.00

Data are presented from an analysis of radioinduced mutations in wheat. Seeds of *Triticum durum* and a diploid species, *T. monoccum*, were exposed to various doses of x radiation ranging from 1500 to 8000 R and plants from four generations were analyzed for a series of characters, including productivity. The use of radioinduced mutations in plant breeding programs is discussed. NSA

N66-18866# Columbia Univ., New York. Dept. of Ophthalmology.
[TRANSPORT AND METABOLISM OF ISOTOPICALLY LABELED MATERIALS IN THE EYE] Final Report
[1965] 6 p refs
(Contract AT(30-1)-2456)
(NYO-2456-1) CFSTI: HC $1.00/MF $0.50

Tritium-labeled thymidine was used as a tracer of DNA synthesis in the rabbit lens *in vivo*. After small mechanical injuries to the anterior surface of the lens a large number of epithelial cells surrounding the site of injury were shown to be stimulated and to undergo DNA synthesis and mitosis. This stimulation of DNA synthesis and mitosis moved in wave-like fashion slowly outward from the site of the injury starting about 12 hr after injury. X radiation at doses of 200, 500, or 100 R inhibited the development of the reaction to injury. Data are included from studies of DNA synthesis and mitosis in isolated rabbit lens maintained in tissue culture. NSA

N66-18906# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE STRUCTURE AND PHOTOCHEMISTRY OF CHLOROPLAST LAMELLAE
John Biggins (Ph.D. Thesis) Jan. 1965 150 p refs
(Contract W-7405-ENG-48)
(VCRL-11863) CFSTI: HC $4.00/MF $1.00

A study was made of the molecular structure of the chloroplast lamellae using biochemical techniques and of the photochemical properties of reactions that occur during photosynthetic electron transport in the lamellae. Emphasis was placed on quantum efficiencies and wavelength dependences of the reactions in order to further characterize the pigment systems responsible for quantum conversion. Results are reported from studies using chloroplast lamellae from *Spinacia oleracea*. NSA

N66-18955# Hanford Atomic Products Operation, Richland, Wash.
REPRODUCTIVE PERFORMANCE OF X-RAYED SINGLE-SPECIES AND MIXED-SPECIES CULTURES OF *TRIBOLIUM CONFUSUM* AND *T. CASTANEUM* REARED AT DIFFERENT TEMPERATURES
Howard E. Erdman [1964] 20 p refs Submitted for Publication
(Contract AT(43-1)-1350)
(HW-SA-3748) CFSTI: HC $1.00/MF $0.50

Adult flour beetles, *T. confusum* and *T. castaneum*, sexed as pupae and maintained separately for three weeks after adult emergence, were given 0, 1575, or 2625 R of X rays. Single- and mixed-species populations were established and incubated at 25, 29, or 32°C at 65 to 70% relative humidity. Productivity was determined during 10 weeks post-irradiation. Reproductive abilities increased with increased temperature and decreased with increased X-ray exposure for a given temperature. The reproductive fitness of *Tribolium castaneum* was superior in all environments except at 0 R, 32°C. The frequencies of dominant lethals (which included lethality due to coexistence in mixed-species populations) increased with higher X-ray doses, but temperature and cohabitation influenced their expression within a species. Coexistence was responsible for a considerable reduction of productivity, which was also altered by temperature and X radiation. The rigors of coexistence were lessened at 2625 R exposures (undoubtedly due to reduced population density). Interpretations of dose-response curves on the bases of single-hit and multi-hit radiation phenomena were inferred from similar responses of diverse organisms. Most lethality occurred in the early (eggs to young larvae) part of the life cycle for both species. Species proportions in coexistent populations varied with temperature and X radiation but *T. castaneum* was consistently superior compared to *T. confusum*. The greater variability of *T. castaneum* probably makes it more fit in environments featuring different temperatures and X-radiation exposures plus coexistence. Responses to radiation of single-species populations cannot be used to predict those of mixed-species populations. Author (NSA)

N66-18965# Association Claude Bernard, Paris (France).
RESEARCH RELATING TO THE STUDY OF RADIATION EFFECTS ON THE FUNCTIONS AND ENZYMATIC POTENTIAL OF PLATELETS Annual Report, 1963–1964 [RECHERCHE SUR L'ETUDE DES EFFETS DES RADIATIONS SUR LES FONCTIONS ET L'EQUIPEMENT
J. Caen Jun. 1965 20 p refs In FRENCH
(EURATOM-019-63-3 BIOF)
(EUR-2438.f)

After exposure of platelet-rich citrated plasma to X-ray doses varying from 50 to 800 R, the following results were obtained: no change in the number of platelets; a few morphological alterations in 2 to 10% of the cells, even after a 50 R dose; the total adhesion of platelets to the glass was retarded; spontaneous platelet aggregation was increased; in the presence of extrinsic ADP, aggregation of the platelets was reduced; and thrombin-treated irradiated platelets released less ADP than non-irradiated platelets. It was concluded that irradiation activates the platelet ATPases, releases intrinsic ADP, and causes spontaneous hyperaggregability; the cells thus damaged by X-rays are less sensitive to extrinsic ADP, and they are also less sensitive to thrombin, which normally releases intrinsic ADP, which is found to a less extent after irradiation. Author (NSA)

N66-19009# Joint Publications Research Service, Washington, D. C.
VESTNIK OF THE USSR ACADEMY OF MEDICAL SCIENCES, VOLUME XX, NO. 11, 1965
23 Feb. 1966 184 p refs Transl. into ENGLISH of Vestn. Akad. Med. Nauk SSSR (Moscow), v. 20, no. 11, 1965 p 1–103
(JPRS-34244; TT-66-30685) CFSTI: $5.00

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1. REPRODUCTION OF HUMAN DISEASES IN ANIMALS (THE CHOICE OF EXPERIMENTAL ANIMALS B. A. Lapin p 1–15 refs

2. CHARACTERISTICS OF THE DISTRIBUTION AND MICROSCOPIC STRUCTURE OF CORONARY ARTERIES IN CERTAIN VERTEBRATE ANIMALS AND THEIR SIGNIFICANCE IN THE REPRODUCTION OF EXPERIMENTAL ATHEROSCLEROSIS T. A. Sinitsyna p 16–28 refs

3. COMPARATIVE PHYSIOLOGICAL CHARACTERISTICS OF EXPERIMENTAL NEUROSES IN VERTEBRATES N. I. Lagutina and A. F. Sysoyeva p 29–45 refs

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N66-19010 Joint Publications Research Service, Washington, D. C.
COMPARATIVE CHARACTERISTICS OF RADIATION SICKNESS IN VARIOUS MAMMAL SPECIES, INCLUDING PRIMATES
L. F. Semenov and L. A. Yakoleva *In its* Vestn. of the USSR Acad. of Med. Sci., V. 20, No. 11, 1965 23 Feb. 1966 p 79–93 refs (See N66-19009 09-04) CFSTI: $5.00

This paper cites comparative data on the nature of acute radiation sickness, as well as on the effect produced by higher radiation doses in mammals (mice, rats, guinea pigs, rabbits, dogs, and monkeys). Findings proving general similarity in the development of radiation processes in animals and in man were confirmed. A number of differences marking the manifestation of individual syndromes in diverse mammal species were established, the resemblance of acute radiation sickness in man and in apes being the greatest, as compared to other animals. M.R.W.

N66-19155# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Departement Protection Sanitaire.
RADIOACTIVE CONTAMINATION LEVELS IN THE ENVIRONMENT AND IN THE FOOD CHAIN [NIVEAUX DE CONTAMINATION RADIOACTIVE DU MILIEU AMBIANT ET DE LA CHAINE ALIMENTAIRE] Annual Report, 1965
Brussels, EURATOM, 1965 32 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-003-63-10 PSAF)
(EUR-2520.f) CFSTI: HC $2.00/MF $0.50

This report describes the main items studied under the EUR-CEA contract of association during 1964. The studies previously initiated on transit in the gastro-intestinal tract and iodine metabolism in children were pushed ahead and some partial results obtained. The gastro-intestinal tract study was rounded off by the elaboration of a new mathematical model. The food chain studies were completed and work was started on the analysis of these data. Partial results concerning average consumption were obtained. The study on the transfer of radioactive contamination from pollution sources to foodstuffs was carried out by means of a progressive method of approach. Author

N66-19168*# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY A Summary of Progress, 1 Jan.–31 Dec. 1965
R. G. Lindberg and J. J. Gambino [1965] 73 p refs
(Contract NASw-812)
(NASA-CR-70871) CFSTI: HC $3.00/MF $0.75 CSCL 06C

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3. GROWTH AND DEVELOPMENT OF THE LITTLE POCKET MOUSE *PEROGNATHUS LONGIMEMBRIS* P. Hayden and J. J. Gambino 21 p

4. THE RADIOBIOLOGY OF THE POCKET MOUSE J. J. Gambino and R. G. Lindberg 16 p refs

N66-19180# Flying Personnel Research Committee, London (England).

A PRELIMINARY STUDY OF FLIGHT DECK WORK LOADS IN CIVIL AIR TRANSPORT AIRCRAFT

Aug. 1965 50 p refs

(FPRC-1240) CFSTI: HC $2.00/MF $0.50

Sixteen scheduled transatlantic sectors were flown in BOAC Boeing 707 aircraft, each with an observer and a volunteer subject—the aircraft captain. A continuous recording of the captain's heart rate was made on the tape, together with a simultaneous commentary by the observer. At the same time the captain's total output of urine was collected in individual samples for subsequent biochemical analysis, which included adrenaline and noradrenaline. Cockpit environment and crew activities were also noted, as also was the captain's post flight 'fatigue state'. It was found that the pilots' heart rates showed changes that were associated with particular phases of flight and which varied with the circumstances under which the flights were made. The biochemical measurements reflected the unexceptional nature of the environments and the overall demand upon the pilots in these flights. Author

N66-19191*# Naval School of Aviation Medicine, Pensacola, Fla.

ARCHITECTURE OF THE OTOLITH END ORGAN: WITH SOME FUNCTIONAL CONSIDERATIONS

Makoto Igarashi 8 Dec. 1965 19 p refs Joint report with NASA *Its* Rept.-127

(NASA Order R-93)

(NASA-CR-70597; NAMI-952) CFSTI: HC $1.00/MF $0.50 CSCL 06E

The otolithic membrane is extremely fragile and is easily destroyed by post-mortem changes, tonic change, strong chemicals, et cetera. The routine technique of temporal bone preparation usually includes the use of a strong fixative and decalcifier; therefore, the structural preservation of this structure in histological slides is uncertain. An attempt was made to preserve the otolithic architecture as naturally as possible. In studying squirrel monkey temporal bones the results obtained with three different decalcifiers are compared. The best architectural preservation of the otolithic end organ was obtained after 10% formalin fixation, dehydration, celloidin embedding, and 10% EDTA decalcification. The morphological features of this end organ are discussed from the functional viewpoint. It is confirmed that, except for the otoconia, basically both otolith and semicircular canal end organs have almost similar components. Author

N66-19203# School of Aerospace Medicine, Brooks AFB, Tex.

A UNIFIED APPROACH TO THE ANALYSIS OF HUMAN SERUM LIPIDS FOR CLINICAL INVESTIGATION, 1962–1964

Dorothy F. Wease Sep. 1965 19 p refs

(SAM-TR-65-45; AD-474253)

A method is described by which the organic solvent-soluble components of 1 ml. of serum are extracted and purified. The extract is dried and weighed to determine the total lipid content. The dried extract is then redissolved in petroleum ether and pipetted onto a prepared column of silicic acid from which the four major components (cholesteryl esters, non-esterified cholesterol, glycerides, and phospholipids) are eluted separately and are quantitated by spectrophotometric methods. Detailed procedures are given for each step in the analysis. Author (TAB)

N66-19266*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS OF SPACE BIOLOGY, VOLUME 4

N. M. Sisakyan, ed Mar. 1966 686 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom IV", Moscow, Izd.-Vo Akad. Nauk SSSR, 1965

(NASA-TT-F-368) CFSTI: HC $6.50/MF $3.25

A collection of journal articles on medical and biological investigations under terrestrial conditions, results of experiments conducted on orbital spacecraft, results of test stand and laboratory tests on animals, and general problems of space biology and methodology are presented. For individual titles see N66-19267–N66-19344.

N66-19270* National Aeronautics and Space Administration, Washington, D. C.

EFFECTS OF EIGHT-HOUR ISOLATION AND HYPOKINESIA ON SEVERAL PHYSIOLOGICAL AND BIOCHEMICAL INDICES IN MAN

V. S. Georgiyevskiy, L. I. Kaplurin, A. N. Kalinina, B. S. Katkovskiy, V. V. Kustov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 22–25 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Experiments with 10 healthy young men indicate that eight hours isolation and hypokinesia do not induce functional changes in man. Results do show a statistically significant decrease in blood carboxyhemoglobin content and serum cholinsterase activity. Blood catalase index increased following isolation and hypokinesia. There was a tendency for urine ammonia and urea to decrease. With regard to the cardiovascular system, there was a 16% decrease in pulse rate, a 23% increase in peripheral resistance, and no changes in EKG except for a tendency to bradycardia. Changes in external respiratory functions were within normal physiological limits, except for a tendency toward slowing in the rate of forced inhalation. M.W.R.

N66-19271* National Aeronautics and Space Administration, Washington, D. C.

EFFECT ON THE HUMAN ORGANISM OF PROLONGED CONFINEMENT IN A SMALL HERMETICALLY SEALED CHAMBER

N. A. Agadzhanyan, Yu. P. Bizin, G. P. Doronin, Ye. A. Il'in, A. G Kuznetsov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 26–37 refs (See N66-19266 09-04) CFSTI: HC $.50/MF $3.25

Literature from the United States and the U.S.S.R. is surveyed for information dealing with the confinement of men in pressure chambers, and it is concluded that individuals respond differently to the monotony caused by prolonged isolation in small sealed areas. The need to create a stimulating atmosphere is stressed. Results of one experiment indicate that work capability can be maintained during 30 days of confinement, even though many physiological reactions are noted. Experiments also show that prolonged restricted mobility and decreased flow of external strimuli markedly reduce the lability of nerve cells of the cerbral cortex and change the relations between fundamental nervous processes in the direction of inhibition. Functional tests indicate a considerable decrease in adaptability of body mechanisms to physical exertion, and a

sharp increase in excitability of the blood circulatory apparatus. In an investigation of gas exchange during an isolation period, oxygen consumption decreased 32% while carbon dioxide exhalation decreased 26%. M.W.R.

N66-19272* National Aeronautics and Space Administration, Washington, D. C.
REACTION OF THE HUMAN ORGANISM TO IMPACT ACCELERATION STRESS ACTING IN VARIOUS DIRECTIONS
G. P. Mirolyubov *In its* Probl. of Space Bioo., Vol. 4 Mar. 1966 p 38–47 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Investigations indicate that the human organism can tolerate an impact acceleration of braking of considerable intensity without impairment to his working capability or the occurrence of pathological changes. A specially equipped ground-based apparatus was used, and impact acceleration stress was created by braking the cabin with different kinds of shock absorbers. Statements by the subjects involved in the experiment indicate that longitudinal shocks were felt more severely than lateral ones. Impact acceleration exerted on the subjects' heads was greater than that recorded for the chair. There were no significant deviations in the functioning of individual organs or systems 15 to 20 minutes after landing. It is noted that arterial pressure takes longer to return to normal than does pulse rate. M.W.R.

N66-19273* National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF FUNCTIONAL CHARACTERISTICS AND INTERACTION OF THE OTOLITHIC AND CUPULAR PORTIONS OF THE VESTIBULAR APPARATUS UNDER CONDITIONS OF ALTERED GRAVITY
Ye. M. Yuganov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 48–63 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Special features of the vestibular apparatus were studied during conditions of altered gravity in order to investigate excitability during increased and lowered weight conditions. Investigations of the otoliths indicate that the duration of postrotational nystagmus decreases during weightlessness. All the subjects stated that rotation was easier to undergo during weightlessness than on the ground. Analysis of data indicates that excitation threshold of the vestibular apparatus is greater during weightlessness than on the ground. When a caloric test was conducted 20 minutes before rotation and during the third minute of acceleration, the duration of caloric nystagmus during acceleration increased considerably over those values recorded prior to the test. It is concluded that weightlessness does not produce a functional disconnection in the otolithic apparatus and that centrifugal forces induce nystagmic reaction. The strength and character of this reaction are determined not only by the magnitude of acceleration but also the type of changes which occur. It is shown that stimulation of the otoliths can produce both inhibition and activation of the nystagmic reaction. M.W.R.

N66-19274* National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF HUMAN RESISTANCE TO SHORT-TERM ANGULAR ACCELERATIONS OF LARGE MAGNITUDES
V. M. Tardov, B. V. Ustyushin, and S. F. Orlov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 64–67 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The effect of angular accelerations of short duration and large magnitudes is studied on six healthy male subjects rotated about the longitudinal axes of their bodies. No nystagmus resulted from ± 30 to ± 90 units/sec^2, but more prolonged accelerations of 0.3 to 0.5 units-sec^2 at 17 to 32 sec produced nystagmus in every instance. Immediately after the rotating chair stopped, subjects exhibited a higher rate of cardiac contraction. Both systolic and diastolic pressures increased, although pulse pressure hardly changed. In about 20 to 30 min, systolic pressure returned to normal, while diastolic pressure, although declining, was above the pre-acceleration rate. There is an increase in respiratory rate immediately after short-duration angular acceleration, but this rate quickly returns to normal. On the basis of EEGs, it is shown that there is excitation in the central nervous system immediately after acceleration. It is concluded that the human responses to short-term angular acceleration are mixed in with psychological reactions. It was found that when subjects were prepared for rotation but not actually subjected to the acceleration, physiological changes of the same kind but less pronounced than for true rotation occurred. M.W.R.

N66-19275* National Aeronautics and Space Administration, Washington, D. C.
CHANGES IN SEVERAL PHYSIOLOGICAL AND BIOCHEMICAL INDICES IN MAN AFTER EXPOSURE TO SMALL CONCENTRATIONS OF CARBON MONOXIDE
V. V. Kustov, V. I. Mikhaylov, Z. I Pilipyuk, Yu. N. Tokarev, V. S. Georgiyevskiy et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 68–74 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

While minimum physiological shifts were observed in healthy young males subjected to carbon monoxide concentration of 0.011 to 0.012 mg/liter during an 8-hour experiment in a hermetically sealed chamber, there are indications that the effects were not due entirely to CO hypoxemia. Tissue effect of CO is considered a prime factor. Blood carboxyhemoglobin content was found to be only 1.5% following exposure in contrast to 0.66% before. Serum cholinesterase activity rose from 100 to 107% after CO exposure, and catalase index from 3.70 to 3.73. Prior to exposure, the eight subjects made an average of two mistakes during 10 minutes work; after exposure this rose to 5.87 errors. Efficiency of work was lowered following the exposure test. M.W.R.

N66-19276* National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF ACCLIMATIZATION TO HIGH-MOUNTAIN CONDITIONS ON HUMAN RESISTANCE TO HYPOXIA
Ye. N. Salatsinskaya *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 75–81 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Thirty-eight mountain climbers were observed during a study to determine the difference between resistance of acclimatized and nonacclimatized individuals to hypoxia at high altitudes (1650 m). Amplitude and rate of respiration were recorded on a kymograph; and testing was carried out in a Krogh apparatus filled with air, with soda lime absorbing the carbon dioxide. Handwriting samples of the subjects were checked at the same time they were describing their reactions. Testing was stopped with the onset of marked cyanosis or tremor, although these phenomena did not appear in several subjects. For these, change in handwriting was the signal to stop. Climbing produced a more unfavorable reaction to hypoxia in the nonacclimatized subjects than those who were acclimatized. Resistance to hypoxia after 20 days in the mountains was found to increase in both groups by about the same amount. Change in oxygen saturation of the blood was determined by oxyhemography and showed lower saturation for the acclimatized subjects prior to ascent; during the ascent, however, both groups had equal drops. Handwriting changes during the hypoxic testing were almost identical for both groups. It is considered likely

that this is due to the previous athletic training of all the subjects rather than acclimatization to mountain climbing.
M.W.R.

N66-19277* National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE TRANSMISSION CAPACITY OF THE HUMAN VISUAL SYSTEM
A. A. Nevskaya *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 82–95 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Information transmission capacity (ITC) of the visual system was determined by the rate at which a human being perceives images whose information content is known, with the evaluation confined to the shape of silhouetted objects and geometric designs. With short display times, subjects did not always identify patterns correctly. When subjects were trained to recognize a limited collection of patterns, identification time diminished. When viewing time was long, it was found that observers recognized all patterns without error. Results indicate that pattern recognition is determined not only by the properties of a concrete given object, but also by the entire combination of visual models comprising the group. The ITC concept is found to be inapplicable to some systems, as in the case of recognition of very simple configurations. The ITC of the visual system is found to drop with decrease in dimensions of the patterns shown, but most of this is attributed to a corresponding decrease in line thickness. Up to a certain threshold, brightness and screening do not affect ITC; there is a sharp drop in both when the threshold is reached. M.W.R.

N66-19278* National Aeronautics and Space Administration, Washington, D. C.
PECULIARITIES OF HUMAN AUDITORY SENSITIVITY UNDER CONDITIONS OF CONTINUOUS AND PROLONGED MEDIUM INTENSITY NOISE
Yu V. Krylov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 96–100 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Results of auditory sensitivity tests are presented for eight subjects exposed to noise in a free acoustic field while they remained in a small sealed chamber for between 27 and 60 days. Maximum noise intensity was 60 to 65 db at frequencies of 800 to 1800 cps, and auditory thresholds were investigated at frequencies from 125 to 8000 cps. Threshold changes are divided into three stages, with the maximum increase in auditory threshold occurring during the first stage, particularly on the first day of the experiment. In the next four or five days there is a threshold drop. The second stage, which encompasses the major part of the experiment, or 23 to 24 days in the 30-day tests, is characterized by considerable stability of auditory sensitivity. During the last days of the experiment, termed the third stage, there is a lowering of auditory thresholds, which may be related to the subjects' anticipating the end of the experiment. Restoration of auditory sensitivity occurs 15 to 20 minutes following cessation of noise, and repeated testing for several months following the experiment showed the subjects to have fully regained their auditory functions. M.W.R.

N66-19279* National Aeronautics and Space Administration, Washington, D. C.
SOME DATA ON THE ANIMAL LINK IN A CLOSED ECOLOGICAL SYSTEM
I. A. Abakumova, K. S. Akhlebininskiy, V. P. Bychkov, N. G. Demochkina, Yu. I. Kondrat'yev et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 101–112 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Chickens and ducks are considered to be the most suitable animals for inclusion in space flights because of the ease in incubating eggs, relative weight of offspring, good supply of protein which will result, and general feeding problems inherent to a closed ecological system. Various tables summarize data related to the turnover of flocks of chickens and ducks in terms of animal protein supply for a cosmonaut, as well as oxygen requirements and carbon dioxide release for various age fowl. Calculations indicate that while chickens require less feed to produce similar quantities of nutrients, they require more oxygen and release more carbon dioxide than ducks. Ducks can eat a large quantity of green fodder, such as chlorella and haulm, and they mature more quickly than chickens. M.W.R.

N66-19280* National Aeronautics and Space Administration, Washington, D. C.
PROSPECTS FOR PHARMACOLOGICAL PROTECTION FROM RADIATION INJURY DURING SPACEFLIGHT
P. P. Saksonov, V. V. Antipov, N. N. Dobrov, V. S. Shashkov, V. A. Kozlov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 113–120 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A general review is presented of possibilities for pharmacological protection from radiation injury during space flights. The possibility of increasing the resistance of biological objects to the injurious effects of ionizing radiation has been demonstrated in principle, and experiments are now necessary to study chemical radioprotective properties under conditions which simulate the hazards of flight. M.W.R.

N66-19281* National Aeronautics and Space Administration, Washington, D. C.
BIOLOGICAL EVALUATION OF RADIATION CONDITIONS ON AN EARTH–MOON TRAJECTORY
Yu. M. Volynkin, V. V. Antipov, V. A. Guda, M. D. Nikitin, and P. P. Saksonov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 121–132 refs Presented at the 15th Intern. Astronautic Congr., Warsaw, 7–12 Oct. 1964 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

An examination is made of the radiation picture in peri-terrestrial space to determine the danger from ionizing particles which man might encounter in his flight trajectory from Earth to Moon. Primary cosmic rays are considered, and the daily dose of these rays in outer space is tabulated for different groups of particles. Total dosages received by Soviet cosmonauts during Vostok flights are also given. Ionizing irradiations of the Earth's radiation belts are considered, as are chromospheric flares on the sun. On the basis of measurements of radiations, it is concluded that a protection of 1–2 g/cm^2 would be adequate for space crew members for a two-week flight during a period of quiet solar activity. With the threat from protons of solar flares it would be desirable to increase physical protection to 3 g/cm^2. M.W.R.

N66-19282* National Aeronautics and Space Administration, Washington, D. C.
ANTIRADIATION PROTECTION IN CONNECTION WITH THE PROBLEM OF THE RELATIVE BIOLOGICAL EFFECTIVENESS OF RADIATIONS WITH LOW SPECIFIC IONIZATIONS
S. P. Yarmonenko and A. G. Konoplyannikov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 133–162 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The relative biological effectiveness (RBE) of hard radiations of electromagnetic nature is discussed, and a table summarizes data for X-rays and gamma radiations. Standard and comparable

radiation are given, with the type of rays and linear energy loss (LEL) for each. Analysis of these findings indicates a decrease in RBE occurring with a decrease in LEL. The RBEs are also tabulated for protons, deuterons, and high energy alpha particles with a low LEL; and the same general patterns are found as for radiations with low specific ionization. Aminothiol and indolyl alkylamine derivatives are shown to be the most effective protectors against proton, gamma, and X-rays. Results of experiments involving the use of modifying agents at the cellular and organismic levels confirm the fact that LEL value plays an important part in the radiobiological effects of ionizing radiations, regardless of their physical nature. Effectiveness of protection against irradiation of haploid and diploid yeast cells is tabulated for a great many agents, and comparative effectiveness is shown in experiments with mice. M.W.R.

N66-19283* National Aeronautics and Space Administration, Washington, D. C.

NEW ASPECTS OF PERSONAL HYGIENE

V. V. Lavashov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 163–165 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Hygienic maintenance of the body during space flight conditions is discussed in general terms, and the need for more scientific research to develop definitive procedures is stressed. Development of personal hygiene measures should include a variety of maintenance and precautionary procedures. M.W.R.

N66-19288* National Aeronautics and Space Administration, Washington, D. C.

APPLICATION OF SOME OF THE CONCEPTS OF INFORMATION THEORY TO THE ANALYSIS OF PHYSIOLOGICAL DATA OBTAINED DURING SPACEFLIGHTS

A. D. Yegorov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 201–212 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Cardiac contraction, respiration, and pulse rates obtained during space flights are analyzed in terms of information theory concepts. Since the physiological systems of the organism contain some degree of indeterminacy, a quantitative determination is made. The degree of indeterminacy is shown to be dependent upon the number of possible intervals within which the physiological indicators can lie and on the probability with which they appear in any of these intervals. Entropy is the measure of indeterminancy in information theory; and the physiological interpretation of entropy as a measure of indeterminacy is shown to be very similar to dispersion as a measure of unsteadiness. By information theory it is shown that the entropy of a combined system of random quantities is equal to the entropy of one of its component parts plus the apparent entropy of the second part with respect to the first. Interrelation between random quantities and the zero hypothesis is also discussed. M.W.R.

N66-19290* National Aeronautics and Space Administration, Washington, D. C.

SOME PHYSIOLOGICAL DATA FOR EVALUATING THE CONDITION AND WORK CAPACITY OF COSMONAUTS IN ORBITAL FLIGHT

A. D. Voskresenskiy, O. G. Gazenko, G. V. Izosimov, V. I. Kopanev, D. G. Maksimov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 222–230 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Data from electroencephapalograms, galvanocutaneous reactions, and electrooculographs are found to reflect the physical and psychoemotional condition of cosmonauts subjected to prolonged space flights. Both EEG changes and the sharp reduction in oculomotor activity serve as warnings of approaching fatigue, but it is emphasized that such changes observed during space travel are not accompanied by subjective feelings of approaching fatigue, vestibular system impairment, or noticeable decrease in work capability. Sample EEG recordings and average number of galvanocutaneous reactions are given for cosmonauts Bykovskiy and Tereshkova, and nystagmic ocular movements are illustrated for the latter. M.W.R.

N66-19291* National Aeronautics and Space Administration, Washington, D. C.

SOME RESULTS OF BIOMEDICAL INVESTIGATIONS CONDUCTED DURING THE TRAINING PERIOD AND FLIGHTS OF V. F. BYKOVSKIY AND V. V. TERESHKOVA

V. I. Yazdovskiy, M. D. Yemel'yanov, P. V. Vasil'yev, and V. I. Kopanev *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 231–238 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Results are presented for physiological investigations conducted during the training and actual flight of Cosmonauts Bykovskiy and Tereskova. Increase in the pulse and respiratory rates and shortening of the intervals of the EKG and seismogram are reported for the prelaunch period, when the spacecraft went into orbit, and during descent to Earth. During the orbital portion, Bykovskiy exhibited gradual normalization of the pulse and respiratory rates, lengthening of the EKG, and intensified bioelectric activity of the cerebral cortex; and low frequency oscillations were noted for Tereshkova. Work capacity during weightlessness is considered to have remained at a fairly high level. Biomedical methods and tests used during investigations on Earth, in aircraft, and in spacecraft are discussed; along with radiation safety, microclimate in the spacecraft cabin, and training and feeding of cosmonauts. M.W.R.

N66-19292* National Aeronautics and Space Administration, Washington, D. C.

RESULTS OF BIOLOGICAL INVESTIGATIONS CONDUCTED DURING FLIGHTS OF "VOSTOK" TYPE VEHICLES WITH THE PARTICIPATION OF COSMONAUTS A. G. NIKOLAYEV, P. R. POPOVICH, AND V. F. BYKOVSKIY

V. V. Antipov, N. L. Delone, G. P. Parfenov, and V. G. Vysotskiy *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 239–251 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Results are presented for experiments dealing with the reproductive processes in Drosophila melanogaster under conditions of weightlessness, and the study of space flight factors which affect the hereditary structure in Tradescantia paludosa. The hypothesis is advanced that chromosome rearrangements result from dynamic factors occurring during lift-off and descent of the spacecraft, and that weightlessness does not cause such rearrangements. The data do not eliminate, however, the possibility that weightlessness may cause disruptions of the mitotic mechanism. Also observed were the formation of excrescences in cells, giant cells, and disrupted synchrony of microspore development, but the individual flight factors causing these cannot be determined. Experiments with the flies indicated that breeding time was increased from the usual nine to 15 days for eggs laid during weightlessness. More females were hatched than males, and several ideas are advanced to explain this, including space travel affects the y-chromosomes' utility, a loss of y-chromosomes during meiosis, or that the female larvae were more fit. M.W.R.

N66-19293* National Aeronautics and Space Administration, Washington, D. C.

RESULTS OF MICROBIOLOGICAL AND CYTOLOGICAL INVESTIGATIONS CONDUCTED DURING THE FLIGHTS OF "VOSTOK" TYPE VEHICLES

N. N. Zhukov-Verezhnikov, N. I. Rybakov, V. A. Kozlov, P. P. Saksonov, N. N. Dobrov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 252–259 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The combined action of irradiation and vibration appears to have had a genetic effect on lysogenic bacteria exposed during Vostok space flights. Vibration seems to increase the sensitivity of these bacteria to cosmic radiation. Weightlessness, in combination with ionizing radiation, may be another source of genetic change. Experiments indicate that the number of phage-producing cells in Escherichia coli increases with exposure to factors peculiar to space flights. It was also found that reexposed human cell cultures of HeLa strains on Vostoks 4 and 6 had a longer latent period for restoration of growth capability than did cells exposed to one space flight or those used as laboratory controls. M.W.R.

N66-19294* National Aeronautics and Space Administration, Washington, D. C.

REACTIONS OF COSMONAUTS TO WEIGHTLESSNESS

I. I. Kas'yan, V. I. Kopanev, and V. I. Yazdovskiy *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 260–277 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Physiological reactions of five cosmonauts are analyzed following brief exposure to weightlessness during aircraft flights along Kepler's parabola as well as after the prolonged weightlessness experienced during Vostok flights. Insignificant differences were noted between motor activity performance during the brief exposures and on Earth. Pulse rates generally increased and cardiac rates decreased, although there was much individual difference noted. Arterial pressure increased during horizontal flight and decreased during weightlessness. Respiratory rate remained almost unchanged in three of the cosmonauts, and increased slightly in the other two. During the actual spaceflights, results obtained appear to be due to both nervous-emotional strain and to weightlessness. The experimental data suggest that there is no significant impairment from weightlessness of between three and five days, except for decrease in cardiac rate, greater variability in physiological indices, and slow return of some of these indices to original values following exposure to weightlessness. M.W.R.

N66-19295* National Aeronautics and Space Administration, Washington, D. C.

SOME NATURAL IMMUNITY FACTORS AND COSMONAUT AUTOFLORA DURING THE TRAINING PERIOD AND FOLLOWING THE FLIGHTS OF "VOSTOK," "VOSTOK 2," "VOSTOK 3," AND "VOSTOK 4"

O. G. Alekseyeva *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 278–289 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Three groups of immunological tests were undertaken to determine the antimicrobial functions of the body and the nature of cosmonaut autoflora during training and Vostok flights. Studies were made of the bactericidal properties of the saliva, skin, and plasma: phagocytic functions of the neutrophils *in vitro* and oral mucosa *in vivo*; and the microflora of the pharynx and of the surface and deep layers of skin. Most of the experiments were conducted in the morning. Immunological changes were found to be transient and, for all practical purposes, insignificant because there was no indication of weakening the cosmonauts' resistance to microbes. Changes were much less pronounced for the cosmonauts undergoing the longer flights of three to four days, indicating an adaptation to flight conditions. Illustrations are included and graphs summarize the findings of the various tests. M.W.R.

N66-19296* National Aeronautics and Space Administration, Washington, D. C.

UTILIZATION OF HIGHER PLANTS AS INDICATORS OF THE EFFECTS OF ORBITAL SPACEEFLIGHT FACTORS ON THE LIVING CELL

N. L. Delone *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 290–293 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A cytological approach was followed in studying chromosomal aberrations, changes in mitosis, and impairment of growth processes in the cells of higher plants during orbital space flights. The development of point mutations in plants such as peas, tomatoes, corn, and barley was investigated genetically by noting offspring changes in the phenotypes. Such methods are discussed in terms of their utilization as effective biodosimeters during space flights. M.W.R.

N66-19297* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF PARTIAL RESTRAINT OF MOTOR ACTIVITIES ON BASIC PHYSIOLOGICAL PROCESSES IN MONKEYS

I. D. Bogina, N. A. Rokotova, Ye. S. Rogovenko, and R. L. Sheykin *In its* Probl. of Space Biol., Vol. 4 Mar. 1965 p 294–300 refs (see N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Stability of the basic physiological processes is observed in monkeys a few hours after they are subjected to partial restraint from a belt and a collar, both fastened to vertical bars clamped on a common base. Monkeys can move their extremities freely and easily change positions; and during prolonged fixation there is no evidence of abdominal muscle weakness or edema of the posterior extremities. Amount of food consumed during these partial restraint periods of between 10 days and four months remained high, and weight gains were observed toward the end of the experiments. Daily checks uncovered no pathological deviations. Data indicate that under conditions of partial restraint the respiration, heart beat, and brain activity of monkeys remained within normal limits. M.W.R.

N66-19298* National Aeronautics and Space Administration, Washington, D. C.

EFFECTS OF PROLONGED OPTOKINETIC STIMULATION ON THE ORGANISM

V. P. Neverov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 301–306 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Optokinetic stimulation was applied to five rabbits fixed in a special holder in a rotating cylinder with 22 black stripes, each 5 cm in width, on its inner surface. Electrooculography, based on recording changes in the corneoretinal potential (CRP) while the eyeball is in motion, was used to record eye movement. All rabbits exhibited differences in optokinetic nystagmus (OKN) amplitude and frequency. Judging from nystagmograms, OKN rhythm slowed because of nystagmic movements to groups of stripes rather than to single stripes. Further testing indicated that after prolonged optokinetic stimulation, the central nervous system, in the presence of stationary objects, conserves traces of the stimuli for a considerable time; and sometimes these traces appear in the form of delayed reverse postoptokinetic nystagmus (RPN). It is speculated that there are common nervous mechanisms for

optokinetic and vestibular nystagmus. The RPN is considered tied to the prolonged circulation of a stimulus in the nerve structures in the absence of an exogenic optokinetic stimulus. M.W.R.

N66-19299* National Aeronautics and Space Administration, Washington, D. C.

THE EFFECTS OF TRANSVERSE ACCELERATIONS ON THE ORGANISM OF FEMALE MONKEYS

A. R. Kotovskaya, P. V. Vasil'yev, B. A. Lapin, S. F. Simpura, V. A. Shakhlamov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 307–316 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Studies were conducted to determine the effect of transverse accelerations on the cardiovascular, respiratory, and reproductive systems of 16 female monkeys between five and eight years of age. Vaginal smears and changes in genital epithelium were examined to determine ovarian-menstrual cycles, and accelerations were applied during the proliferative, secretory, menstruation, and ovulation periods. Fourteen monkeys were sacrificed after rotation; four intact monkeys served as controls, with one sacrificed after each acceleration stage. Breathing and pulse rate increased markedly at the beginning of rotation; and cardiac and respiratory functions became normal in most cases within 10 to 20 minutes after the centrifuge stopped. Autopsies performed on the 14 monkeys revealed gross evidence of venous plethora in the ovaries, uterus, and oviducts. Gross studies indicated morphological deviations to be dependent on the phase of the menstrual cycle, with the most traumatic effects occurring during ovulation. Changes were minimal and rare during the proliferative stage; but it is emphasized that changes were always greatest on the third day of rotation. One of the two monkeys saved later had a normal pregnancy. M.W.R.

N66-19300* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF PROLONGED HYPOKINESIS ON HUMAN RESISTANCE TO ACCELERATIONS

A. R. Kotovskaya, L. I. Kakurin, N. I. Konnova, S. F. Simpura, and I. S. Grishina *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 317–324 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Following hypokinesis for three days (two men) and 20 days (three men), five physically fit males were transferred to a centrifuge while they were still in horizontal positions. No significant differences in ability to undergo 7-unit acceleration were noted before and after the 3-day hypokinesis. After the 20-day period, the three subjects were pale, nervous, and tense; they bore up well under 4-unit, 30-sec accelerations, but visual disorders such as blackout occurred after 7-unit acceleration. None of the 20-day men would undergo 8-unit acceleration, stating as their reasons fear of rotation and general poor feeling. In all cases the intensity of shifts in physiological reactions was noticeably greater in the 20-day men. In two cases maximum tolerance time to acceleration dropped sharply, whereas in one case it remained unaltered. There is evidence of greater stress on the compensatory adaptive mechanisms when accelerations follow prolonged hypokinesis. M.W.R.

N66-19301* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF SMALL CORIOLIS ACCELERATIONS ON THE FUNCTIONAL STATE OF THE HUMAN HEART

R. A. Vartbaronov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 325–329 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Experimental data indicate high adaptability of the human heart to the action of vestibular stimuli in the form of prolonged exposure to small Coriolis accelerations. Changes in heart activity during cumulative Coriolis accelerations fall within normal physiological limits. For a rotation speed of 10.6°/sec, the principal effects were sympathetic in nature; while at 21.6°/sec, changes were largely parasympathetic. During functional tests at the latter rotation, the effect became sympathetic; and this is attributed to a reduction in functional capability of the heart as a result of extracardiac factors. Very small physiological deviations are observed for cardiac activity, even in the cases of clearly articulated motion sickness. The possibility of cardiac adaptation is considered in the case of prolonged exposure to small Coriolis accelerations. M.W.R.

N66-19302* National Aeronautics and Space Administration, Washington, D. C.

CHARACTER OF EEG AND WORK CAPACITY IN MAN DURING EXPOSURE TO BACK-CHEST ACCELERATIONS

A. S. Barer and V. B. Zubavin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 330–340 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

In order to investigate human compensatory reactions to traverse accelerations, a study was made of the character of EEG alterations and the level of work capacity during exposure to back-chest accelerations. Eighteen subjects were tested on a large radius centrifuge at angles of 65, 78, and 90° to the longitudinal axis of the body. Tests were made from six to 12 G. During 65° back-chest accelerations, EEG changes appear to be of two varieties. At six and eight G, there is increased activity of fast components during the plateau period, a return of EEG to its initial level, and a relative increase of the slow components against a general rise of all EEG components. The 10 G acceleration appears to be a transition zone between the first group and the group containing 12 G accelerations and higher, where at the beginning of the plateau period there is a selective relative increase in slow rhythms against an increase in all EEG components. In the after-effect period, the slow rhythms continue to rise. The appearance of slow EEG rhythms is related to recombination shifts which lead to hindrance of blood circulation in the brain. M.W.R.

N66-19303* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF ROTATION ON THE HUMAN ORGANISM WITH THE TRUNK INCLINED AT VARIOUS ANGLES

A. R. Mansurov and S. S. Markaryan *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 341–345 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Effects of angular accelerations on the human organism were studied at various rotation speeds and torso-inclination angles. Generally, pulse rate and respiration increased with rotation speed buildup and these rates went back to normal or below during acceleration plateaus. Systolic blood pressure usually increased, and diastole decreased. Displacement of internal organs, compression of the larynx, and difficulty in swallowing were experienced during rotations at 65, 80, and 90°. Repeated rotations in the vertical sitting position resulted in changes in X-rays of the chest, mostly evidenced by greater transparency of the lower lungs and intensification of lung shadows at or near the radix. There were enlargements of the heart and major vessels, but these and the lung shadows disappeared between five and seven days after testing. Persons who are less resistive to the effects of angular accelerations

experience considerable changes in the contractive function of the heart following rotation; and this is accompanied by heart enlargement and slowed pulse rate. There is a good deal of variation among individuals from exposure to angular accelerations. M.W.R.

N66-19304* National Aeronautics and Space Administration, Washington, D. C.

THE NATURE OF THE BIOLOGICAL EFFECT OF VIBRATION

S. N. Romanov, R. A. Romanova, and Z. I. Monastyrshina *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 346–350 refs (See N66-19266 09-04) CFSTI: HC $6.00/MF $3.25

Both *in situ* and *in vitro* tests were conducted on white mice exposed to 30-minute period of vibration at a 2-mm amplitude. The *in situ* tests were at frequencies from 25 to 75 cps, with the tissues stained by an intravenous solution of neutral red prior to vibration. For the *in vitro* tests at 25 cps frequency, organs were stained after their removal from the mice. For both types of tests, the various organs display different degrees of sensitivity to vibration. The extent of reactive changes in the cells appears to be related to the various vibration parameters, especially frequency. It is concluded that all cells in the organism are capable of sensing vibration effects. M.W.R.

N66-19305* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF COMBINED EXPOSURE TO ACCELERATION, VIBRATION AND RADIATION ON BONE MARROW CELL NUCLEI IN MICE

M. A. Arsen'yeva, L. A. Belyayeva, and A. V. Golovkina *In its* Probl. of Space Bioo., Vol. 4 Mar. 1966 p 351–367 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Bone marrow cell nuclei in white and hybrid mice were studied following exposure to accelerations of various duration and strength and to radiation, combined with centrifugation and vibration. Accelerations of five minutes at 20 G showed a lower mitotic activity, chromosome adhesion, and increase in chromosome rearrangement frequency than 5-minute acceleration at eight G. At 15-minute accelerations, similar changes are created at both strengths, with a sharper drop in mitotic activity at 20 G. Sixty minutes after irradiation with acceleration mitotic activity of bone marrow cells is low, but a rise follows which is substantially less for the combined tests than for X-irradiation by itself. Reduced radiation effects are evidenced when the mice are subjected to prior centrifugation or vibration, caused by a reduction of true chromosome-rearrangement frequency. It is considered possible that chromosome adhesion in some way induces healing of ruptures created by radiation. At any rate, it is indicated that various physiological changes, produced by the action of acceleration or vibration, bring about aberrations in cell division which give rise to a protective effect against radiation. M.W.R.

N66-19306* National Aeronautics and Space Administration, Washington, D. C.

ADAPTATIONAL READJUSTMENTS IN THE ORGANISM OF MICE DURING AND AFTER EXPOSURE TO ELEVATED CO_2 CONCENTRATIONS

A. I. Koreshkin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 368–377 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Various experiments are reviewed relating to the exposure of mice to narcotic concentrations of carbon dioxide. Data on changes in the reaction of the respiratory system and motor apparatus in the course of 48-hour exposure to CO_2 showed a marked increase in breathing throughout as well as reduction in motor activity. While gas exchange experiments did not produce statistically significant results, there was a tendency to increase respiration in the first hours following exposure to 7.5% CO_2. This was followed by a drop in both oxygen consumption and CO_2 excretion. It is concluded mice adapt to the new environment as they build up increased resistence and decreased susceptibility to CO_2 during the first two days of exposure. A weakening of the adaptive condition occurs several days after exposure cessation. The present findings are considered in keeping with other studies which indicate that reorganization of the enzyme system and compensation for disturbances in acid–alkali equilibrium require long periods of time. M.W.R.

N66-19307* National Aeronautics and Space Administration, Washington, D. C.

INJURIOUS EFFECT OF 660 AND 120 MeV PROTONS AND THE EFFICACY OF PHARMACOLOGICAL AND CHEMICAL PROTECTION

V. S. Shashkov and V. S. Morozov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 378–387 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Agents which provide protection against gamma radiation and X-rays retain their effectiveness against high energy proton radiation. Relative biological effectiveness (RBE) for mice exposed to 120 and 660 MeV protons is no greater than one when compared with electromagnetic radiation. Data are presented for the following preparations, introduced intra-abdominally 10 to 15 minutes prior to radiation: cysteamine, AET, serotonin, 5-methoxytryptamine, tryptamine, and 5-oxytryptophan. While survival in the control group was 1.7% for 660 MeV protons and 3.3% for 120 MeV protons, survival rates 30 days after exposure were as high as 81.2% with pharmacochemical protection. Although the results obtained are not consistent, they do indicate the need for further search on chemical protective agents. M.W.R.

N66-19308* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF SCREENING INDIVIDUAL PARTS OF THE BODY OF ANIMALS ON CHANGES IN RADIATION REACTION AND EXPOSURE TO GAMMA RAYS AND HIGH-ENERGY PROTONS

B. L. Razgovorov, V. S. Morozov, V. S. Shashkov, V. V. Antipov, N. N. Dobrov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 388–404 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Data are presented concerning the influence of shielding various sectors of the body during total body irradiation of white desexed rats by gamma rays and 120 MeV protons. With 800 to 1,050 rad dose, rate of survival was not increased by head shielding whereas abdomen shielding gave increased survival by 50%. Caution is suggested in interpreting these results which do not agree with previously obtained data. For gamma rays at 930 rad, increases in survival of 30, 44.8 and 88.3%, respectively, were noted from shielding the head, both haunches, and abdomen. In other experiments, shielding the abdomen with an organic glass block 6 cm wide during 800 to 1,050 rad proton irradiation raised the survival rate of rats to 86.4% as compared to 19.4% in the control group. A 4 cm block lowered survival to 77.8%, and a 2 cm block gave a survival rate of only 50%. Similar results were attributed to shield widths tested for 1,100 to 1,300 rad proton doses and 930, 1,100, and 1,400 rad gamma rays. Abdominal shielding is found to decrease weight losses in the animals. M.W.R.

N66-19309* National Aeronautics and Space Administration, Washington, D. C.

MORPHOLOGICAL CHANGES IN THE HEMATOPOIETIC ORGANS OF MICE IRRADIATED WITH HIGH-ENERGY PROTONS

N. A. Gaydamakin, V. G. Petrukhin, V. S. Shashkov, V. V. Antipov, and P. P. Saksonov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 405–411 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Three groups of adult male mice, with 30 in each, were studied to determine pathomorphological changes in the spleen and thymus following exposure to protons and gamma rays as compared to a control group which received no radiation. A statistically significant decrease in weight coefficients of the spleen and thymus is evidenced on the third day in proton-irradiated mice; for the spleen there is a continued decrease evidenced on the 7th day, but an increase follows so that at 60 days the weight coefficient is greater than in the control group. A more gradual increase is noted for the thymus, and again the weight coefficient on the 60th day is greater for the proton-irradiated group than the control animals. Differences between weight coefficients for the proton and gamma groups are considered statistically insignificant, but all changes were less pronounced following 830 rad proton dosages than after the 650 r gamma ray exposures. Although less pronounced than after gamma irradiation, the initial destruction of bone marrow in the proton-irradiated animals does not show clear signs of restoration until the 7th day. At this point, restoration signs in the gamma-irradiated animals are barely visible. M.W.R.

N66-19310* National Aeronautics and Space Administration, Washington, D. C.

RESISTANCE OF RATS TO SEVERE OXYGEN DEFICIENCY DURING RADIATION SICKNESS

S. V. Gasteva, K. P. Ivanov, and D. A. Chetverikov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 412–418 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Acute radiation sickness, manifested by marked gastrointestinal disturbances, resulted three days after male white rats weighing 200 to 250 g were subjected to whole body X-irradiation with 750 r. By the end of the fourth day only 30% of the 178 irradiated animals were alive. Rat resistance to acute hypoxia increased within six hours after irradiation. Peak resistance occurred 72 hours after exposure, apparently due to the decrease in intensity of the metabolic processes of the sick organisms as well as to slight hypothermia and the diminishing rate of gas exchange in the animals. Resistance to hypoxia decreased 96 hours after exposure, and is attributed to impairment in all vital functions and general weakening of the animals. At the earlier stages of radiation sickness, hypoxia resistance may possibly be caused by increased resistance to the ionizing radiation. It is concluded that ionizing radiations of the doses used in this experiment do not injure the tissue oxidative systems, since a comparatively constant rate of gas exchange and body temperature was found for the irradiated animals throughout the experiment. M.W.R.

N66-19311* National Aeronautics and Space Administration, Washington, D.C.

NEW WAYS OF STUDYING CHEMICAL PROTECTION AGAINST GENETIC CHANGES

N. N. Zhukov-Verezhnikov, M. N. Volkov, N. I. Rybakov, P. P. Saksonov, V. A. Kozlov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 419–424 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Chemical compounds of the aminothiol group and analogs of pyrimidine bases were analyzed for prophylactic properties against genetic damage to lysogenic bacteria caused by X-irradiation. An evaluation was made of the induced phage particle formation in irradiated specimens of Escherichia coli treated with the various chemicals in contrast to phage production in an untreated specimen. Beta-mercaptopropylamine was found to be most effective in inhibiting phage growth; it was found that phage production was 119 times greater in the control specimen. It is suggested that additional protection could be obtained from this compound by use of other acids to form salt compounds. Compounds in which the first hydrosulfide group occupies a more extreme position seem to possess less effectiveness. Absence of antigenetic action was found in 3-beta-aminoethylisothiuronium hydrobromide. M.W.R.

N66-19312* National Aeronautics and Space Administration, Washington, D.C.

SIGNIFICANCE OF THE PROCESS OF POSTRADIATION REGENERATION OF GENETIC STRUCTURES FOR THE RADIOSENSITIVITY OF CELLS. COMMUNICATION I: QUANTITATIVE LAWS OF POST RADIATION RESTORATION OF YEAST CELLS

V. S. Barsukov, O. V. Malinovskiy, and N. M. Mityushova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 425–433 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

In order to investigate genetic injuries due to radiation and the degree to which radiation damage to cytoplasm affects the chromosome restoration process, experiments were conducted on a tetraploid strain of Saccharomyces cerevisiae. A three-day yeast culture was irradiated with Cobalt 60 at a dose power of 1300 rad/min, with temperature held at 4° F to prevent regeneration during irradiation. The experiments indicate that radiation-genetic injuries to yeast cells of the dominant lethal type are largely reversible and are eliminated by the massive participation of cytoplasm. Restoration of genetic structures is accomplished by the entire cell functioning as a system, and the degree of radiation damage to the cytoplasm is determined by the regeneration rate of these structures. M.W.R.

N66-19313* National Aeronautics and Space Administration, Washington, D.C.

SIGNIFICANCE OF THE PROCESS OF POSTRADIATION REGENERATION OF GENETIC STRUCTURES FOR THE RADIOSENSITIVITY OF CELLS. COMMUNICATION 2: RADIOSENSITIVITY OF YEAST CELLS OF VARIOUS PLOIDY

V. S. Barsukov, O. V. Malinovskiy, and N. M. Mityushova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 434–441 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Diploid and tetroploid strains of Saccharomyces cerevisiae yeast of two series were studied to determine if differences in the radiosensitivity of yeasts of various ploidy were due to differences in the regeneration processes. A three-day yeast culture was irradiated with Cobalt 60 at a dose power of 1300 rad/min, with temperature held at 4° F to prevent regeneration during irradiation. Tetraploid cells of the Ef series were found to be more stable than tetraploid cells of the M series, indicating that there is no immediate relationship between radiosensitivity and ploidy. Survival rate appears to be practically independent of ploidy and the number of primary cells injuries. The intensity of the regeneration process appears to depend chiefly on the degree of radiation damage to the cytoplasm which promotes the restoration. The present data, along with those obtained for mammalian cells, indicate that the fate of an irradiated organism is determined mainly by regenerated cells rather than cells which have avoided radiation. M.W.R.

N66-19314* National Aeronautics and Space Administration, Washington, D. C.

ELIMINATION OF INJURIOUS EFFECTS OF BETA RADIATION ON SEEDS OF CULTIVATED PLANTS BY MEANS OF PHYSIOLOGICALLY ACTIVE COMPOUNDS

Yu. I. Shaydarov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 442–446 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Various protective agents were used on irradiated samples of corn, lupine, turnips, and winter wheat to determine if effects from large doses of beta radiation of phosphorus 32 could be eliminated from the seeds produced by the exposed plants. Experimental data indicate harmful results in the second generation for winter wheat, with an 18% decrease in weight of the grain. When compound P-46 (a pyridyl-naphthoquinone-sulfanilamide) was used in combination with P^{32}, this weight decrease was eliminated. Treating corn seeds with radioactive phosphorus reduces the weight of the foliage, but this is increased with the addition of P-46, as well as by 4,4-di-trichloroacetyl-diaminophenyl sulfone, 2-ketononanoic acid, and a cultural fluid of antibiotics. Soaking seeds with these compounds without P^{32} exposure generally yields higher foliage than when the seeds are treated in water solution. Lupine was found to be less responsive than corn to both the ionizing radiation and the chemical compounds. Treatment of turnip seeds had virtually no effect on the yield of roots and tops. M.W.R.

N66-19315* National Aeronautics and Space Administration, Washington, D. C.

ULTRAVIOLET IRRADIATION OF PLANTS AS A PROBLEM IN SPACE PHOTOPHYSIOLOGY

A. A. Shakhov, S. V. Shishchenko, S. A. Stanko, V. S. Shaydurov, and B. M. Golubkova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 447–458 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

An investigation was made of the effects of ultraviolet radiation on photosynthesis as related to space physiology of plants in a closed ecological system. Data are tabulated for pigment content in leaves, following radiation exposure of about 10 $\mu V/cm^2$, of samples of fodder cabbage, beet, turnip, pea, bean, and barley. Chlorophyll content as well as carotin, lutein, violaxanthin, and carotenoid totals are presented. Spectral properties of various plants and photosynthesis measurements are also included. Data indicate that the chloroplasts and pigments in some plants are quite resistant to ultraviolet dosages, and that short wave ultraviolet at certain levels stimulates biosynthesis of pigments. Measurements in wild plants growing at 5000 m above sea level indicate that photosynthesis proceeds within the usual normal limits for certain plants and is higher for others. M.W.R.

N66-19316* National Aeronautics and Space Administration, Washington, D. C.

VOLUNTARY CHOICE BY ANIMALS OF GAS MEDIA WITH VARIOUS OXYGEN CONTENTS UNDER NORMAL CONDITIONS AND AFTER EXPOSURE TO A HYPEROXIC ATMOSPHERE

I. S. Breslav *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 459–463 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Preferences of mice for atmospheres containing various amounts of oxygen were investigated following their exposure to a hyperoxic medium for from six to 10 days, and a comparison was made of choices of mice taken for a normal atmosphere. The previously unexposed mice showed a negative preference for a 60% oxygen atmosphere and even less preference for a 90% atmosphere. Preferences were determined by the relative positions of the mice in the chambers with increased oxygen. The animals previously exposed for six to eight days showed a definite preference for the higher oxygen content, whereas after 10 days in a 60% oxygen medium the mice showed a weak negative response to the increased oxygen. Three days after the mice were transferred to an air environment, there was evidence that the exposed group required less oxygen than the control group. It is concluded that while these findings may be related to metabolic changes or to a decrease in excitability of central nervous system functions, further investigations are needed. M.W.R.

N66-19317* National Aeronautics and Space Administration, Washington, D. C.

EFFECTS OF INCREASED PARTIAL PRESSURE OF OXYGEN ON THE MORPHOLOGICAL COMPOSITION OF THE PERIPHERAL BLOOD IN ANIMALS

I. S. Breslav and A. M. Shmeleva *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 464–473 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Peripheral blood morphology was investigated in mice exposed for varying periods of time to environments with increased partial pressure of oxygen. Following exposure for 1.5 hours in pure oxygen at 2.5 atm, there was an increase in number of erythrocytes and a lesser increase in hemoglobin concentration. Three days after the experiment there was a sharp drop in hemoglobin as well as color index and reticulocyte content, but a return to normal was noted on the seventh day. Immediately after 36 hours exposure to 60% oxygen there was a slight decrease in hemoglobin and an elevation in erythrocyte count. The original values were restored in three days, but both indices decreased considerably on the seventh day. After 36-hour exposures to 90% oxygen, there was a sharp decrease in erythrocyte count, particularly reticulocytes. Hemoglobin concentration was unchanged at first, decreased three days after the exposure, and by the seventh day red cells tended to return to normal. During 10-day exposure to 60% oxygen an initial increase in indices was noted, but this was followed by a steady decrease in both erythrocyte and reticulocyte counts. By the sixth day of the experiment both hemoglobin concentration and color index increased, but the counts continued to decrease. M.W.R.

N66-19318* National Aeronautics and Space Administration, Washington, D. C.

ADAPTATION TO DIFFERENT FORMS OF HYPOXIA. COMMUNICATION 1: EFFECT OF GRADUAL AND SUDDEN HYPOXIA

V. A. Konstantinov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 474–482 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

While distinct adaptation reactions appeared in cats subjected to gradual decrease in oxygen content, a sudden change to breathing an air mixture of five to seven percent oxygen caused transient motor restlessness, respiratory disorders, and a rapid drop in blood pressure. Sudden inhalation of a gas mixture containing eight percent oxygen did not result in a respiratory standstill, but a second exposure within 15 to 25 minutes killed the animals. Experimental results indicate that sensitivity to gradual hypoxia may decrease because of sluggish compensatory mechanisms or the activation of certain emergency defense mechanisms. This adaptation appears to be unrelated to body temperature. M.W.R.

N66-19319* National Aeronautics and Space Administration, Washington, D. C.

ADAPTATION TO DIFFERENT FORMS OF HYPOXIA. COMMUNICATION 2: CHARACTERISTICS OF THE COURSE OF EXTREME HYPOXIA

V. A. Konstantinov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 483–488 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Superacute or extreme oxygen deficiency that develops immediately was investigated by giving pure nitrogen under normal pressure to 35 anesthetized cats. Following respiratory standstill, oxygen was given and artificial respiration was started. Duration of hypoxia is considered to be the interval between supplying nitrogen and starting artificial respiration. It was found that repeated oxygen deficiency occurred in a similar fashion in each of the animals, and hypoxia duration appeared to be unrelated to body temperature. Repeated exposures indicated respiratory changes and restoration periods occurring at precisely the same times in succeeding hypoxias. Changes in arterial pressure and oxygen saturation of the blood were similar. Substitution of nitrous oxide for inert nitrogen failed to change either the nature or duration of extreme hypoxia. These experiments indicate the duration of extreme hypoxia to be related to both the compensatory physiological mechanisms and the biological properties of hemoglobin and tissues capable of retaining and releasing a definite amount of oxygen. M.W.R.

N66-19320* National Aeronautics and Space Administration, Washington, D. C.

EFFECT ON CERTAIN PHYSIOLOGICAL FUNCTIONS OF PROLONGED EXPOSURE OF ANIMALS TO CONDITIONS OF AN OXYGEN-ENRICHED AIR MEDIUM

A. G. Zhironkin, I. S. Breslav, E. A. Konza, A. L. Il'nitskiy, A. D. Nozdrachev et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 489–502 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Changes in some fundamental functions in mice placed in hermetic chambers for periods of up to 10 days, were investigated in relation to the duration of exposure to an oxygen-enriched air medium and to abrupt changes in the composition of the atmospheric environment. Respiratory rhythm of mice kept in the hyperoxic environment was perceptibly slower than that of control animals; when the exposed animals were returned to an air environment, respiration accelerated but did not reach the levels of the unexposed mice. By the end of the fifth day of hyperoxic exposure, gas exchange rate for the mice began to decrease; the decrease was more marked when these mice were placed in an air environment. Histological examination indicated lowered functioning of the thyroid and decreased follicular epithelium, along with increase in resistance to hypoxia and decrease in excitability of nerve centers. These experiments indicated that breathing 63% oxygen atmospheres for 10-day periods was relatively harmless, but toward the end of exposure there were initial manifestations of pathological action of oxygen in the lungs and blood. M.W.R.

N66-19321* National Aeronautics and Space Administration, Washington, D. C.

AMMONIA AS ONE OF THE COMPONENTS OF THE AIR MEDIUM IN CLOSED COMPARTMENTS

V. I. Mikhaylov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 503–506 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

When 170 male mice were subjected to lethal concentrations of ammonia they assumed positions which would assist their breathing; exhibited body tremors, disturbed motor coordination, and clinical tonic spasms; and eventually died. Autopsy revealed pulmonary edema in a number of cases, lungs were discolored, livers became enlarged, and stomachs and intestines were distended and filled with a frothy substance. Absolute lethal concentrations of ammonia after two-hour exposure was 4.51 mg/liter, and evidence indicated that ammonia had a cumulative effect. In addition to the increase in organ weights and earlier deaths, mice exposed to high doses of ammonia exhibited decreased oxygen consumption and weight lags as compared to animals used as controls. M.W.R.

N66-19322* National Aeronautics and Space Administration, Washington, D. C.

THE PROBLEM OF THE EXCITATORY STATE OF THE EMETIC CENTER IN MOTION SICKNESS

I. D. Pestov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 507–513 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Excitability of the emetic centers of dogs at rest and at different intervals during the experimental production of motion sickness was determined by the minimal doses of apomorphine capable of inducing vomiting. Three delabyrinthed dogs failed to show external signs of motion sickness, and exhibited no patterns for changes in EKG, respiration, arterial pressure, and skin temperature. As rotational angular force and duration increased, the five dogs with intact labyrinths required decreasing doses of apomorphine to produce vomiting, although individual differences existed among the dogs. Excitation of the emetic center is accompanied by deeper breathing and acceleration of cardiac contractions. During severe vomiting EKG shows signs of myocardial hypoxia. Tachycardia is renewed and breathing becomes normal with the cessation of vomiting. In cases where vomiting is induced, pulse rate increased more than in cases where the administration of apomorphine did not induce vomiting. A temporary period of bradycardia during a sudden attack of acute tachycardia is considered symptomatic of oncoming vomiting. M.W.R.

N66-19323* National Aeronautics and Space Administration, Washington, D. C.

AN ELEMENTARY MODEL OF THE VESTIBULAR APPARATUS

O. G. Gazenko, N. A. Chekhonadskiy, A. N. Razumeyev, and B. B. Yegorov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 514–525 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A simple model of the vestibular apparatus is developed to determine the effects of a variable gravitational field on an organism. Receptor characteristics of the otolith part of the vestibular apparatus can be determined by the model. An investigation is made of the reaction of a system consisting of a receptor and a neuron to a G-force which is a step function of time, and graphic representations of the results are presented. The presence of receptor-neuron system canals in the otolithic part of the vestibular apparatus can be explained by the model. Basic feature of this model is a summation device which compares signals arriving from the left and right utricle and from the saccule. This summator explains the nature of motion by animals and birds whose otoliths have been removed. M.W.R.

N66-19324* National Aeronautics and Space Administration, Washington, D. C.

SEMICONDUCTOR COOLER FOR SMALL ANIMALS

Yu. N. Logunov and Yu. S. Alyukhin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 526–529 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A semiconductor cooler to induce hypothermia in small animals employs a thermoelectric battery, a system to remove heat, and a working chamber of copper or aluminum. A selenium rectifier provides the 24 W power required by the cooler which has a working current of 25 A and a voltage drop through the battery of 0.4 V. In a series of tests on rats anesthetized at room temperature, the average cooling rate was 0.15°C per min until a rectal temperature of 27°C was reached. When hexenal in doses of 0.2 to 0.7 mg/g body weight was given the rats, cooling rate averaged 0.17°C per min. When rats were placed in the cooler immediately after a hexenal injection of 0.9 mg/g body weight, average cooling rate increased to 0.39°C per min. In this last series, adymia was more complete and less shivering was evidenced. Since the principal obstacle to increasing the cooling rate is the persistence of thermoregulatory reactions in anesthetized animals, two experiments were conducted by cooling rats immediately after their deaths. In one case cooling rate averaged 0.39°C per min for cooling to 27°C; in the other average rate was 0.48°C per min to reach 24°C. M.W.R.

N66-19325* National Aeronautics and Space Administration, Washington, D. C.

ELECTRICAL METHOD OF RECORDING TONGUE MOVEMENTS DURING ARTICULATION OF COSMONAUTS

Yu. I. Kuz'min *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 530–541 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A sensor, developed to record contact between tongue and palate, was used to test responses of six human subjects during articulation of consonants. Referred to as dynamic palatography, the method was used to study speech formation mechanisms and the reception of speech by making continuous recordings of the position of the tongue. Since the noise level of the experimental recording sessions was quite low, the signals were detected automatically with considerable reliability. The application of the method had no effect on the intelligibility of the speech recorded, and the results obtained corresponded to definite articulation positions. It is considered that the significant results from such a method are not the signal combinations produced but rather the sequence of the signals. A detailed investigation of the time structure of speech signals is necessary to establish methods for automatic perception of speech. M.W.R.

N66-19326* National Aeronautics and Space Administration, Washington, D. C.

AUTOMATIC APPARATUS FOR PRODUCING REVERSIBLE AND REGULATED HYPOTHERMIA FOR POSSIBLE USE UNDER SPACEFLIGHT CONDITIONS

Ye. V. Maystrakh, G. N. Il'yutkin, V. A. Konstantinov, I. V. Yeremenko, S. A. Krasil'nikov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 542–549 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Equipment to automatically induce and regulate hypothermia is described which uses solid state transistors and germanium diodes, and standard logic circuits of the AND, OR, NOT variety. In effect, it is shown that under conditions of hypothermia with anesthesia, control of functions by the organism is replaced to a certain extent by automatic machine control to maintain functions within assigned safe limits. Experiments conducted with 16 dogs indicated the stability of the automatic equipment. Body temperatures were cooled to assigned levels, hypothermia and narcosis were maintained for specified periods of time up to 24 hours, and the animals were automatically returned to normal. Further details of the experiment are not included. M.W.R.

N66-19327* National Aeronautics and Space Administration, Washington, D. C.

METHOD OF RECORDING ACTION CURRENTS IN AUTOMATIC NERVES UNDER CHRONIC (CONTINUOUS) EXPERIMENTAL CONDITIONS

A. D. Nozdrachev *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 550–555 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

In order to record action currents in different parts of the autonomic nervous system for long periods of time, a method was developed to implant electrodes into the splanchnic and sinus nerves of the pre- and postganglionic branches of the caudal mesenteric ganglion. Construction of the platinum electrodes and the implantation process are detailed. The method was verified by conducting experiments with oscillograph recordings of the same nerve formations, which gave the comparable results for short-term recordings and the long-term implantations. Action currents are illustrated for a dog ten months after the implantation. M.W.R.

N66-19328* National Aeronautics and Space Administration, Washington, D. C.

METHOD FOR RECORDING VENOUS OUTFLOW IN CEREBRAL VESSELS OF ANIMALS DURING EXPOSURE TO ACCELERATION

V. Ya. Klimovitskiy and V. F. Nikolayev *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 556–561 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

A method is developed to record the blood flow rate in large surface cerebral veins of experimental animals under conditions that simulate space flight. Heat exchange takes place through the blood vessel and one-stage heating is employed. The device consists of an audio generator, a bridge with a thermistor, and an amplifier. Heaters are connected by means of a time relay unit with two thyratrons. Experiments were conducted on rabbits under G conditions of five at the head, eight at the thorax, and 10 at the abdomen. During the first day there were four rotation periods of 30 sec each, at intervals of 20 to 30 min. Increase of venous outflow was clearly evidenced during the period of thermal cycle which took place for each rotation during the first runs of the centrifuge. Some decrease in outflow and cerebral temperature occurred during the next runs, and there were even greater drops in subsequent runs. On the second and third days of the experiment, when the rotation load was increased to 1–1.5 min, only a decrease in venous outflow was recorded. These changes are attributed to a gradual depletion of compensatory mechanisms. M.W.R.

N66-19329* National Aeronautics and Space Administration, Washington, D. C.

COURSE AND SEQUELAE OF BODY COOLING BY CONTROLLED HYPOTHERMIA

G. N. Il'yutkin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 562–566 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Thirteen dogs were used for a series of experiments involving manual and automatic control of hypothermia. Observations made over a period of a year following cooling, except for one dog who was subjected to six cooling exposures during a two-year period, indicated no sharp variations in body weights and temperature or peripheral blood picture. Leukocytosis and flabbiness were observed in some of the animals, but such deviations usually disappeared three to five days after hypothermia. M.W.R.

N66-19330* National Aeronautics and Space Administration, Washington, D. C.

PROCESSING HUMAN EXCREMENT BY MEANS OF NATURALLY OCCURRING ALGAL AND BACTERIAL POPULATIONS

M. S. Rerberg, T. I. Vorob'yeva, R. I. Kuz'mina, and I. M. Barkhatova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 567–573 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

In order to develop a method for biological treatment of human excretions to reclaim water, a preliminary study was made with a culture of protococcoid algae, chlorella vulgaris, and bacteria. There was no deterioration of the algobacterial system after extensive cultivation on human excretions for a 10-month period. Major disadvantage of the method was the length of time required to treat a daily portion of excreta and the 1.5–2 months required to regenerate the water; and efforts were made to speed these up. These experiments were followed by 5-month investigations in a water-closed system to determine what irreversible changes accumulate and what destructive factors exist in a closed algobacterial system. It was found that mineral salts reached a saturation point, which led to pH fluctuation of the medium. Many humus-type organic substances were accumulated; while the insoluble ones could be removed, the soluble ones were responsible for the eventual destruction of the system. Physicochemical methods are suggested for the removal of such substances. Water regeneration was shown to be feasible, although additional study is necessary to make the water acceptable for drinking. M.W.R.

N66-19333* National Aeronautics and Space Administration, Washington, D. C.

THE ROLE OF VISIBLE ARTICULATION IN SPEECH RECOGNITION

V. V. Alyakrinskiy *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 588–598 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Tests were conducted with six senior class students who had lost their hearing between the ages of 5 and 9 (i.e., when they already had command of speech). The test subjects carefully followed the articulation movements of a single speaker who pronounced 250 meaningless syllables designed to take into account all the possible sound combinations in the Russian language. In addition, in order to clarify the difference in the recognition of accented and unaccented vowels, 200 words and sound combinations consisting of two open syllables were pronounced. In half the sound combinations, the accent was on the first syllable, while in the other half it was on the second syllable. The written answers of the test subjects were used to prepare matrices which reflected the nature of the visual recognition of vowels and consonants, and the matrices were used in turn to determine the intelligibility, the amount of transmitted and received information, and the analysis of error distribution. Analysis of the results indicates that the visual recognition of speech from the observable manifestations of articulation is determined primarily by the supply of words, and their grammatic combinations which are stored in a persons memory and which are necessary for comparison with external signals. L.S.

N66-19334* National Aeronautics and Space Administration, Washington, D. C.

THE PROBLEM OF METHODS IN THE FORMATION OF MOTOR HABIT SEQUENCES BY MAN

N. A. Rokotova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 599–608 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Experiments were conducted in which test subjects of both sexes in the age group 17 to 25 (college students) were given instructions for extinguishing a signal lamp through the correct sequence order of operating keys to a panel. The purpose of the experiment was to study the formation of habit sequences by humans. The results of the teaching experiment are tabulated and discussed. All 15 test subjects learned to reproduce the program without error. The program consisted of 20 transmissions from key to key, and on the average required 34 repetitions of the sequence. Curves showing the probability for the selection of valid and invalid combinations during the initial training period are presented. Other similar motor experiments were conducted, and the results are also discussed. L.S.

N66-19335* National Aeronautics and Space Administration, Washington, D. C.

AUTOMATIC ANALYSIS OF DIURNAL PERIODIC CHANGES IN HUMAN ELECTROENCEPHALOGRAM

D. I. Ivanov, V. B. Malkin, V. L. Popkov, Ye. O. Popova, and I. N. Chernyakov *In its* Probl. in Space Biol., Vol. 4 Mar. 1966 p 609–612 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Electroencephalogram EEG tracings were made four times daily on six healthy men between the ages of 20 and 23 (10 a.m., 5 p.m., 1 a.m., and 5 a.m.) for periods ranging from 10 to 30 days during both sleeping and non-sleeping hrs. Simultaneous recordings were made of the EKG, pneumogram, and arterial blood pressure. Frequency analyses were made of the Δ, Θ, α, and β_H rhythms (14 to 20 cps). A periodometer determined the frequency characteristics of each EEG wave, which were used to establish the number of oscillations of a specific frequency per unit of time. The distribution of waves according to frequency was used to detect frequency variations within each physiological rhythm of the EEG. The composite bioelectric intensity (EMS) of the EEG, as well as the EMS of individual biocurrent rhythms were calculated on an integrator. A total of 295 frequency spectrograms of the EEG were studied and 467 computations of EMS were made. The results are discussed further. L.S.

N66-19336* National Aeronautics and Space Administration, Washington, D. C.

EXPERIMENTAL CONFINEMENT OF FISH IN HERMETICALLY SEALED AQUARIUMS WITH AND WITHOUT CHLORELLA

L. M. Antsyshkina, N. S. Kirilenko, V. Ya. Mamontov, G. B. Mel'nikov, and F. P. Ryabov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 613–620 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Experiments in a closed ecological system consisting of Chlorella algae and fish in a hermetically sealed aquarium were conducted. Chlorella was considered solely as a source of oxygen. The aquariums were filled with fixed amounts of tap water, Chlorella in the required concentration, and previously weighed fish. The water was tested for oxygen and carbon dioxide content and the initial concentration of Chlorella, and then sealed hermetically. Throughout the course of the experiment the temperature was taken and the behavior of the fish was observed three times daily. The length of each experiment was determined by how long the fish lived. The final concentrations of oxygen, carbon dioxide and Chlorella were measured after the fish died without disturbing the hermetic seal of the aquariums. Two series of experiments were carried out. In the first series the aquarium had two compartments, one in which the fish was kept and the other in which the Chlorella was kept. Both compartments had a common air cushion

through which diffusion of gases operated in both directions. The fish were thus supplied with oxygen produced by Chlorella (by photosynthesis), but were not allowed to feed on the Chlorella. In the second series of experiments the fish were kept together with Chlorella and the air cushion was absent. The algae cells provided the fish with oxygen and also served as food for them. Control aquariums were also set up. The results of the data from the investigations are presented in tables and are discussed in detail. L.S.

N66-19337* National Aeronautics and Space Administration, Washington, D. C.

VARIANT METHOD FOR DETERMINING MAXIMUM CHLORELLA PHOTOSYNTHESIS

Ye. A. Ivanov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 621–623 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The results of Chlorella photosynthesis experiments are processed using a value called the cell growth tempo T_p. The value is expressed by an analogy with Shmal'gauzens formula $T_p = 1/n \cdot dn/dt$, where n is the density of the cell culture (the number of cells per unit of suspension volume), and t is the time. Integration was performed to obtain the expression for the current value of the culture density, and a value q is introduced to indicate the volume of oxygen released by each cell during the time of its growth. The expression for the amount of oxygen Q produced by the suspension during time t is given in terms of cell culture density at the moment in time t=0, q, and V, where V is the volume of the algae suspension. The rate of release of oxygen is determined. On the basis of experimental data supplied, the value for T_p was calculated to be $3 \times 10^{-5} sec^{-1}$. The data show that in principle only one liter of Chlorella suspension is sufficient to provide a person with oxygen (560 liters per day are required). In order to attain such high productivity with a dense culture, it is necessary and sufficient to duplicate the conditions for culturing algae by making them conform to those that exist in diluted suspensions. L.S.

N66-19339* National Aeronautics and Space Administration, Washington, D. C.

SPECIAL FEATURES OF PLANT FEEDING UNDER CONDITIONS OF AEROPONIC CULTIVATION FOR A CLOSED SYSTEM

I. V. Tsvetkova, Yu. I. Shaydarov, and V. M. Abramova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 637–642 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The absorption of elements in mineral plant food (from solutions consisting of mineralized human metabolites) by a plant system was studied. Also investigated is the effect on the rate of absorption of chlorine and sodium ions when the concentration of chlorides in the nutrient solution is increased. A nutrient solution was periodically and automatically sprayed in the area of a Chinese cabbage plant's root system (30 sec every 20 min) kept in a closed air space saturated with water vapors. The concentration of sodium chloride in the mineral mixture was increased from 0.02% to 2.0% (by chlorine-ion count). A control experiment where the plants were cultivated on a mineral mixture without salinization; and an experiment where the plants were raised on solutions of human waste products, adjusted for shortage of mineral nutrients were also run. Analyses of the basic mineral nutrients absorbed by the cabbage plants were made, and the tabulated data indicate that mineralized human metabolites can be used for the cultivation of higher plants, with appropriate adjustments for the shortage of mineral nutrient elements. L.S.

N66-19340* National Aeronautics and Space Administration, Washington, D. C.

CONDITIONS OF CARBON NUTRITION OF CHLORELLA IN INTENSIVE CULTURES

G. I. Meleshko and L. M. Krasotchenko *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 643–649 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Curves depicting the relationship between photosynthesis intensity in chlorella culture medium and carbon dioxide concentration in air, at several different suspension densities are presented. The experimental data and the conditions of carbon nutrition are discussed and compared with similar experiments reported in the literature on the photosynthetic saturation of chlorella in air. L.S.

N66-19341* National Aeronautics and Space Administration, Washington, D. C.

DENSE CONTINUOUS CULTIVATION OF CHLORELLA UNDER VARIOUS ILLUMINATION CONDITIONS

V. A. Batov, V. N. Belyanin, I. I. Gitel'zon, B. G. Kovrov, F. Ya. Sid'ko et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 650–653 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The optical illumination of chlorella algae suspensions with a high concentration of cells in a continuous intensive cultivation was determined. The tests were made with suspensions of a thermophilic strain of algae having densities of 2×10^9, 3×10^9, and 4×10^9 cells per milliliter, or 20, 30, and 40 g of dry biological mass per liter of suspension, respectively. Air with high CO_2 was blown through the culture suspension. Temperature was maintained at 35.5°C; pH=7.35; layer thickness=5 mm; and CO_2 content in air was 5%. The data were plotted. The curves show that an increase in illumination is at first followed by a rapid productivity growth of the culture medium. A point is reached where at a certain intensity of illumination the growth become insignificant, indicating that further increase in illumination is no longer conducive to a marked accretion of productivity. Distinctly different illumination levels facilitating maximum productivity were achieved for the cultivation conditions outlined above. L.S.

N66-19342* National Aeronautics and Space Administration, Washington, D. C.

UTILIZATION OF ELEMENTS OF MINERAL NUTRITION BY CHLORELLA CELLS IN INTENSIVE CULTIVATION

Ye. K. Lebedeva, G. I. Meleshko, and A. N. Shakhova *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 654–661 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Chlorella was cultivated in a Tamiy medium prepared with distilled water with 5 g KNO_3, 2.5 g $MgSO_4 \cdot 7H_2O$, and 1.25 g KH_2PO_4 per liter, 1.2 mg Fe^{+2}, and microelements which can be stabilized by the addition of 37 mg ethylenediaminetetraacetate. The chlorella suspension was cultivated in an enclosed airspace at 39°C to 40°C and with a 3% to 5% carbon dioxide concentration, and was illuminated around the clock. The increment of the biological mass by dry weight, the optical density of the suspension, the pH, and concentration of the elements in the medium were periodically determined. Nitrogen, phosphorus, magnesium, sulfur, potassium, and iron determinations were made for the chlorella biological mass. The tabulated composition data facilitated an approximate calculation of the culture medium; and indicate the manner in which the mineral nutrition elements are utilized by chlorella cells during intensive cultivation. L.S.

N66-19343* National Aeronautics and Space Administration, Washington, D. C.

CHANGES IN HEMATOCRIT INDICES AND GAS COMPOSITION OF ARTERIAL BLOOD IN WHITE RATS DURING ARTIFICIAL HYPOTHERMIA

G. D. Glod *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 662–668 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

The effectiveness of several methods of inducing artificial hypothermia in white rats of both sexes in connection with their respiration were evaluated. The oxygen and carbon dioxide composition of arterial blood samples under various degrees of hypothermia were determined; and the samples were hematocritically tested. Curves showing the change in hematocrit index, and oxygen content (with respect to body temperature) in the rats as produced by artificial hypothermia are given. The results of the investigation are discussed, and indicate that the methods used should be considered for use. The method of hypothermia under conditions of growing hypoxia was found to be most effective. L.S.

N66-19344* National Aeronautics and Space Administration, Washington, D. C.

MODEL OF RADIATION CONDITIONS ON A CIRCUMLUNAR TRAJECTORY DURING A SOLAR FLARE

Y. S. Morozov, V. S. Shashkov, B. I. Davydov, V. V. Antipov, P. P. Saksonov et al *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 669–675 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Model experiments were conducted on 278 white mice in a special biological unit to evaluate the biological effects of radiation produced by solar flares during spaceflight. A gamma-cobalt installation was used as the source of ionizing radiation. The exposure dosage was varied to a preset program for both solar flare and flight to moon schemes. Dose strengths vs time are shown. Under the flight to moon scheme, the animals were subjected to an acceleration effect of 20 g for 5 min before the irradiation and at the end of it. Radioprotective drug preparations were introduced into the animals before the solar flare under the flight to moon scheme, and the resulting experimental data are presented in tabular form. The tables show the survivability and lifespan of the irradiated mice under the solar flare scheme; and the protective effect of the chemicals against the irradiation under the flight to the moon scheme. L.S.

N66-19346*# California Univ., Berkeley. Lawrence Radiation Lab.

BIOLOGY AND MEDICINE, SPRING 1965 Semiannual Report

John H. Lawrence, ed. and Tove Neville [1965] 204 p refs (NASA Order R-104; Contract W-7405-ENG-48) (NASA-CR-70522; UCRL-16246) CFSTI: HC $5.00/MF $1.25 CSCL 06R

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N66-19347* California Univ., Berkeley. Lawrence Radiation Lab.

ORGAN VISUALIZATION WITH SCINTILLATION-CAMERA TECHNIQUES

Leonard R. Schaer and Hal O. Anger *In its* Biol. and Med., Spring 1965 [1965] p 36–50 refs (See N66-19346 09-04) CFSTI: HC $5.00/MF $1.25

The use of radioactive isotopes in clinical medicine has become widespread. One application is obtaining pictures of organs wherein gamma-ray- or positron-emitting isotopes have concentrated. These pictures enable one to outline functional parts of the organ, and observe anatomical irregularities

that can be interpreted in the light of clinical symptoms. Described in this report is a scintillation camera. With this camera, photographs of radioactive substances can be taken *in vivo* with short exposure times compared to those necessary with conventional radioisotope scanners. Oblique and other projections of organs can be easily taken. Motion pictures can be made of dynamic processes where indicated. Representative studies of various organs, i.e., brain, thyroid, liver, kidney, bone, and bone marrow, are presented. M.R.W.

N66-19348* California Univ., Berkeley. Lawrence Radiation Lab.

RADIOSENSITIVITY OF THE VESTIBULAR APPARATUS OF THE RABBIT

Larry W. Mc Donald, Gerald A. King, and Cornelius A. Tobias *In its* Biol. and Med., Spring 1965 [1965] p 74–83 refs (See N66-19346 09-04) CFSTI: HC $5.00/MF $1.25

A method of radiating the inner ear of the rabbit with an alpha-particle beam without significant exposure of the brain was devised. Long lasting changes in semicircular-canal function of the rabbit were demonstrated with doses of 500 rads. The approaches used to determine the threshold of radiosensitivity of the semicircular-canal function and the radiosensitivity of the macula utriculi are described. Structural changes are discussed which may account for the functional alterations observed. Work being undertaken to study the structural changes is described. Author

N66-19351* California Univ., Berkeley. Lawrence Radiation Lab.

EFFECTS OF SIMULATED ALTITUDE ON IODINE METABOLISM. I: ACUTE EFFECTS ON SERUM AND THYROID TURNOVER

Gilles LaRoche and Clarence L. Johnson *In its* Biol. and Med., Spring 1965 [1965] p 126–137 refs (See N66-19346 09-04) CFSTI: HC $5.00/MF $1.25

This report shows that simulated altitude (395 mm Hg for a period of up to 15 days) induces a significant change in iodine turnover, as observed through combined I^{125} and I^{127} studies in rats. Experimental procedures and results are summarized. M.R.W.

N66-19352* California Univ., Berkeley. Lawrence Radiation Lab.

ULTRACENTRIFUGE ROTOR TEMPERATURE AND SPEED MEASUREMENT BY RADIO TELEMETRY

Stephen J. Fabricant and Frank T. Lindgren *In its* Biol. and Med., Spring 1965 [1965] p 168–175 refs (See N66-19346 09-04) CFSTI: HC $5.00/MF $1.25
(Grant PHS-G-HE-02029-10)

The principles of radio telemetry were applied in achieving a unique solution to the problem of analytic ultracentrifuge rotor temperature measurement, eliminating the necessity for a direct electrical connection to the rotor. A small transmitter operating in the standard FM band and powered by batteries is mounted in a fixture that is bolted to the rotor. The frequency of the transmitter is a function of rotor temperature, and the amplitude of the received carrier is dependent on the angular relationship of the transmitter to a pickup loop mounted several inches below the rotor. This composite AM and FM signal is detected by an ordinary FM tuner. The output of the FM detector is read on a voltmeter or a recorder as temperature; the AM signal is counted by an electronic counter to display rotor speed in digital form. This system is capable of repeatable temperature measurements accurate to ±0.05°C after appropriate calibration. Also, the system has been used in conjunction with a heater in a feedback loop to provide accurate temperature control of the rotor during the analytical run. Author

N66-19353# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GUIDED AERIAL NAVIGATION IN THE ANIMAL KINGDOM

Shih Wen, Wei Peng, and Yuan Hang 6 Jan. 1966 13 p Transl. into ENGLISH from Hang K'ung Chih Shih (Communist China), no. 4, 1964 p 10–13
(FTD-TT-65-711/1+2+3+4; AD-626952) CFSTI: HC $1.00/MF $0.50

A discussion of processes and mechanisms in animals that provide knowledge or satisfactory explanations of infrared, inertial, echo and guided, geomagnetic, and celestial navigation principles is presented. Discussed are such subjects as missiles equipped with infrared scanning-and-guidance systems named the "Sidewinder" after a snake that possesses a special sense for infrared waves; and the navigation principles and processes of the bat, electric eel, fish, insect, and bird. M.R.W.

N66-19354*# California Univ., Berkeley. Lawrence Radiation Lab.

BIOLOGY AND MEDICINE, FALL 1965 Semiannual Report

John H. Lawrence, ed. and Tove Neville [1966] 115 p refs
(NASA Order R-104; Contract W-7405-ENG-48)
(NASA-CR-70521; UCRL-16613) CFSTI: HC $4.00/MF $1.00
CSCL 06R

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9. THE GENE-INTERACTION COMPONENT OF THE GENETIC LOAD Jack Lester King p 56–65 refs

10. ELECTROPHORETIC STUDIES OF LIGHT-INDUCED CHARGE IN SPINACH CHLOROPLASTS Park S. Nobel and Howard C. Mel p 66–77 refs

11. COLLECTION OF ERYTHROPOIETIN FROM URINE OF PATIENTS WITH ANEMIA SECONDARY TO HOOKWORM Abraham Gutnisky, Mary Lou Nohr, Luis Malgor, and Donald Van Dyke p 78–81 refs

12. ERP STUDIES OF OH RADICAL IN ICE AND SEVERAL CRYSTAL HYDRATES T. E. Gunter p 82–95 refs (See N66-19359 09-06)

13. RETICULOENDOTHELIAL ACTIVITY IN NEONATALLY THYMECTOMIZED MICE AND IRRADIATED MICE THYMECTOMIZED IN ADULT LIFE John C. Schooley, Lola S. Kelly, Ernest L. Dobson, Caroline R. Finney, Virginia W. Havens et al p 96–103 refs

14. HEAVY PARTICLES AND PARKINSON'S DISEASE Robert Tym, John T. Lyman, Robert D. Weyand, Cornelius A. Tobias, Nicholas W. Yanni et al p 104–105

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N66-19355*# California Univ., Berkeley. Lawrence Radiation Lab.

RADIATION DOSES ON MANNED SPACE MISSIONS

Stanley B. Curtis *In its* Biol. and Med., Fall 1965 [1966] p 1–5 refs (See N66-19354 09-04) CFSTI: HC $4.00/MF $1.00

Two of the important factors determining the radiation doses our astronauts will encounter on space missions to be undertaken in the next few years are orbit or trajectory location and spacecraft shielding thickness. In general, earth-orbiters with orbital inclinations up to 30° and altitudes in the 100 to 500 nautical mile range will be free from dangerous levels of radiation. This situation changes as the altitude or orbital inclination increases. On the mission to the moon, the Apollo mission, the danger will come almost entirely from the large solar flares that eject high fluxes of protons and alpha particles capable of penetrating the walls of a lightly shielded vehicle. This paper reviews several consequences of varying the spacecraft trajectory and indicates what dose rates are expected on missions planned in the next few years.

Author

N66-19357* California Univ., Berkeley. Lawrence Radiation Lab.

RECOVERY OF YEAST AFTER EXPOSURE TO DENSELY IONIZING RADIATION

John T. Lyman and Robert H. Haynes *In its* Biol. and Med., Fall 1965 [1966] p 39–46 refs (See N66-19354 09-04) CFSTI: HC $4.00/MF $1.00

A great enhancement of viability is observed if nonnutritive suspensions of diploid yeast, which have been irradiated with X rays or heavy ions (^{4}He, ^{12}C, ^{20}Ne), are stored at 30° C in the dark for four or more hours prior to plating. Maximum recovery is usually observed after 24 to 48 hr; the survival curves obtained upon delayed plating are related to those for immediate plating by a constant dose-modifying factor. Several lines of evidence indicate that recovery is based upon enzymic postirradiation processes unrelated to the initial physicochemical reactions associated with absorption of the radiation. The magnitude of recovery is independent of such radiobiological modifiers as oxygen or glycerol, or track ion density. All these modifiers are thought to act by affecting the nature and distribution of the products of the initial radiochemical reactions. Thus, the recovery appears to be substantially independent of the precise chemical nature of the radiation-induced lesions. Very severe macromolecular damage is likely to be produced by the densely ionizing radiations. The ability of diploid yeast to recover after such irradiation suggests that a "bypass" rather than a direct repair mechanism is involved. Segregation of the damage by sporulation would appear to be, *a priori*, a suitable bypass mechanism, but this hypothesis is ruled out by the results cited in this paper. Author

N66-19358* California Univ., Berkeley. Lawrence Radiation Lab.

UV-INDUCED DOMINANT LETHALITY: EVIDENCE FOR DIFFERENT LETHAL SYSTEMS BETWEEN UV AND X IRRADIATION IN SACCHAROMYCES

Robert L. Wiskocil (Cholate School) *In its* Biol. and Med., Fall 1965 [1966] p 51–55 refs (See N66-19354 09-04) CFSTI: HC $4.00/MF $1.00

Presented are results of a comparative study between UV and X-ray-induced dominant lethality in yeast. Haploid cells from cultures of the yeast *Saccharomyces cerevisiae* were used in the experiment. After irradiation the survival of haploid budding and nonbudding cells was obtained by microscopic single-cell isolation on YEPD slabs. It was concluded that dominant lethals are produced in comparatively greater numbers by UV than by X-irradiation. This difference in the production of dominant lethals gives a basis for assuming that the lethal lesions associated with the two radiations are also different. The fact that UV inactivates a relatively greater number of budding cells than does X-ray substantiates the greater efficiency of UV light in producing dominant lethals. Diploid bud elongations as well as a zygote formation inhibition effect were found to be caused only by UV irradiation. Although the damage is not necessarily lethal, these effects illustrate further differences between ultraviolet- and X-ray induced damage. Experimental procedures, methods, and materials are described.

M.R.W.

N66-19397# AVCO-Everett Research Lab., Everett, Mass.

MOTIONS OF A LIQUID IN A PULSATING BULB WITH APPLICATION TO PROBLEMS OF BLOOD FLOW

Robert T. Jones Dec. 1965 20 p refs

(Contract Nonr-4881(00))

(RR-237; AD-626006) CFSTI: HC $1.00/MF $0.50

Potential flows of the form $\phi=(ax^2+by^2+cz^2)f(t)$ may be utilized to represent motions produced in pulsating bulbs. While the inital bulb shape may be arbitrary, sequential shapes are related by affine transformations. Two components appear in the distribution of pressure, one dependent on the instantaneous velocity and the other on the acceleration. Since the flows have stationary streamlines their inertial impedance is that of a simple mass, and is proportional to the first moment of the actual mass of fluid contained with the bulb. Examples treated are: (1) expanding and collapsing circular cylinders and (2) elliptical cylinders in which the periometer is held constant. The thickness of the pulsatile laminar boundary layer is found to be approximately one millimeter for conditions in the vicinity of the heart. Conditions for separation and turbulence probably differ from those in steady flow. TAB

N66-19412# State Univ. of New York Research Foundation, Albany.

OXIDATION OF THE S-METHYL GROUP BY TISSUE PREPARATIONS Final Report, 1 Jun. 1961–15 Oct. 1965

Edward J. Kuchinskas 17 Jan. 1966 10 p refs

(Contract Nonr-1349(04))

(AD-626855) CFSTI: HC $1.00/MF $0.50

An enzymic activity was detected in tissue homogenates capable of oxidizing the methyl group of methionine and other

S-methyl compounds, completely to carbon dioxide. The activity is present in the highest concentrations in liver and kidney; smaller concentrations are found in brain, heart, skeletal muscle, and erythrocytes. Stable semipurified preparations were prepared from rat liver. Experiments with crystalline beef liver catalase and the rat liver enzyme preparations clearly demonstrated the involvement of catalase in the S-methyl group oxidation process. Various hydrogen peroxide generating systems, both enzymic and chemical, can propagate the peroxidation of the S-methyl groups by catalase. Highly purified rat liver catalase was isolated and was shown to possess similar peroxidation properties as does beef liver catalase. Addition of soluble fractions from rat liver markedly stimulates the peroxidation of S-methyl groups by the rat liver catalase. The involvement of catalase in the oxidation of S-methyl groups to carbon dioxide in vivo was demonstrated by experiments with 3-amino-1,2,4-triazole. This compound inhibits both the catalatic and methyl oxidizing activities of rat liver in a generally proportional manner. Author (TAB)

N66-19421# Aerospace Medical Div. Aerospace Research Lab. (6571st), Holloman AFB, N. Mex.

MONTHLY WEIGHT INCREASES IN GROWING RHESUS MONKEYS

Charles M. Hurst Dec. 1965 22 p refs
(ARL-TR-65-24; AD-626148) CFSTI: HC $1.00/MF $0.50

Weight increase rate profiles were developed for 13 males and 8 female *Macaca mulatta* based on weights recorded within the stereotaxic acceptability weight range of 2.5 to 4.5 kilograms. It was concluded that adolescent female rhesus have a greater weight increase rate than male rhesus with more extreme weights occurring in the individual female samples.
Author (TAB)

N66-19491*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME OBSERVATIONS ON THE STIMULATION OF THE VESTIBULAR SYSTEM OF MAN IN A ROTATING ENVIRONMENT

Ralph W. Stone, Jr. and William Letko [1965] 34 p refs Presented at the Symp. on the Role of the Vestibular Organs in the Exploration of Space, Pensacola, Fla., 20–22 Jan. 1965
(NASA-TM-X-56102) CFSTI: HC $2.00/MF $0.50 CSCL 06S

A review of previous studies and some initial studies are presented in determining the undesirable effects of rotation using a rotating vehicle simulator. The results indicate that the effects of rotation are best evaluated by orienting subjects in earth bound simulators with their long body axis perpendicular to the axis of rotation of the vehicle. The studies also indicate a considerable variation in the stimulation of the various semicircular canals possible among people with normal vestibular functions. The tolerance was generally 10 rpm for most subjects, with no essential effect of radius of rotation on the subjects performance and tolerance to rotation. It is concluded that a movement of the head back from the normal upright position when oriented with the long body axis perpendicular to the axis of rotation may cause some subjects to be less tolerant of nodding motions than if the head was not nodded back. C.T.C.

N66-19493*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WATER CONSUMPTION BY MAN IN A WARM ENVIRONMENT: A STATISTICAL ANALYSIS

John E. Greenleaf, Eugene G. Averkin, and Frederick Sargent, II (Illinois Univ.) [1965] 23 p refs Submitted for Publication
(NASA-TM-X-56118) CFSTI: HC $1.00/MF $0.50 CSCL 06P

A statistical analysis was made of the relationships between 22 selected metabolic variables and the mean daily water consumption in 87 young men. The variables and function tests are given along with details of the testing methods and conditions. A discussion of the results is presented, and it is shown that the following six variables were the most important: mean daily urinary volume, serum osmolarity, lying pulse rate, mean daily urinary Cl, mean daily urinary K, and rate of sweating. C.T.C.

N66-19553# Yokohama Municipal Univ. (Japan). Faculty of Medicine.

THE EFFECT OF COBALT-60 GAMMA RADIATION ON THE CENTRAL NERVOUS SYSTEM Semiannual Report, 4 Aug. 1964–3 Feb. 1965

Akira Tsuya [1965] 10 p refs
(Grant DA-CRD-AG-S-92-544-64-G-24)
(ARDG-FE.J-223; AD-625949) CFSTI: HC $1.00/MF $0.50

Different sensitivity to the ionizing radiation on the various parts of the brain were studied, electroencephalographically. Between the frontal cortex and the hippocampus, different transition of the sleepy stage was demonstrated, suggesting dissociated response in these regions, by irradiation over 1000r. Subcortical structure is remained to be studied for future investigation. Author (TAB)

N66-19642*# Illinois Univ., Urbana. Dept. of Physiology and Biophysics.

THE PHYSICAL AND CHEMICAL PROPERTIES OF HUMAN SWEAT AND FACTORS AFFECTING THE WATER BALANCE IN CONFINED SPACES Semiannual Status Report No. 1, 1 Jul.–31 Dec. 1965

Robert E. Johnson and Frederick Sargent [1966] 17 p refs
(Grant NGR-14-005-050)
(NASA-CR-71199) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The chemical and physical properties of human sweat produced by a combination of heat exposure and exercise on a motor driven treadmill were investigated. Skin preparation and collection of the sweat are described. A comparison was made between the chemical composition of the sweat and its osmotic pressure from the sum of urea, ammonia, sodium, potassium, chloride, and lactate. The cause may lie in the undetermined residual nitrogen fraction. Titration curves were plotted and three pH inflection points identified with ammonia, lactate, and carbonate. Dissociation curves showed the sweat behaves like water. Capillary tube viscosity studies revealed variations from specimen to specimen and implied that the sweat spread on the skin must also vary. The viscosity is higher than that of water at the same temperature. E.A.O.

N66-19667# Liege Univ. (Belgium). Laboratoires de Radiobiologie.

CHEMICAL RADIOPROTECTORS Annual Report, 1 Apr. 1964–1 Apr. 1965 [RADIOPROTECTEURS CHIMIQUES Rapport Annuel, 1 Avr. 1964–1 Avr. 1965]

Brussels, EURATOM, Dec. 1965 12 p In FRENCH; ENGLISH summary
(Contract EURATOM-046-64-3 BIOB)
(EUR-2548.f) CFSTI: HC $1.00/MF $0.50

The importance of the biochemical effects of sulfur containing chemical protectors was confirmed by: (1) inhibition of carbohydrate metabolism; (2) latent period between injection of radioprotector and appearance of decreased response of rats and mice to high dose rate X-irradiation; (3) appearance of early lesions of mitochondria and Golgi apparatus in spleen and lymphoid cells after injection of sulfurous radioprotectors; and (4) alterations of unspecified detoxication hepatic enzyme system. Detailed study was terminated on the action of various protectors on hair growth in normal and irradiated animals. Certain curious anomalies in the chemical protection phenomena are discussed. In the study of salt protective action on barley seeds, the importance of the nature of the anion and cation, of the concentration, of the time interval between application and irradiation, and of the water content of seeds was also established. The mechanism of these protection reactions are also given. E.E.B.

N66-19675# Naval Radiological Defense Lab., San Francisco, Calif.
THE SEQUENCE OF EVENTS IN RADIATION CARCINOGENESIS: A UNIFYING FORMULATION
Leonard J. Cole and Peter C. Nowell (Pennsylvania Univ.) 2 Nov. 1965 30 p refs
(USNRDL-TR-930; AD-624917) CFSTI: HC $2.00/MF $0.50

First, one or more specific mutations are produced in the target cell, either directly or through an indirect mechanism, viral or otherwise. Tumor development begins when the altered cell, having survived the mutating event, is brought into mitosis by a specific or nonspecific proliferative stimulus. Subsequent tumor progression results from repeated additional mutations in the tumor cells with sequential clonal selection from the altered population. Considerations of radiation carcinogenesis in experimental animals, and presumably in man as well, must include the effects of total dose, dose rate and quality of radiation on mutagenesis, and on the survival of mutated cells; and the effects and interactions of both mutagenic and nonmutagenic agents (including viruses, hormones, other environmental factors, and radiation itself) on subsequent tumor development. It is concluded that the complex interplay of many factors and mechanisms—indirect as well as direct—in radiation carcinogenesis makes a simple dose-response relationship untenable. Author (TAB)

N66-19679*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
[MOLECULAR EVOLUTION]—FIRST ANNUAL REPORT
1 Jun. 1965 105 p refs
(Grant NsG-689)
(NASA-CR-71033) CFSTI: HC $4.00/MF $0.75 CSCL 06A

The subject of molecular evolution is defined, personnel at the Institute are identified, and progress and accomplishments of the Institute are summarized. Publications from the Institute are also included. Among the principal accomplishments was the laboratory demonstration of how the protein molecules of which living cells are composed could first have come into existence without cells to produce them. Also, the demonstration of how various attributes of biocells could arise spontaneously, how selective membranes can arise spontaneously from amino acids, how most of the eighteen amino acids common to protein might arise from volcanic reactions in the presence of silica, and how mononucleotides might be polymerized under geologically plausible conditions are among the many listed accomplishments of the Institute. E.E.B.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-18505# Purdue Univ., Lafayette, Ind.
INVESTIGATION OF FUSION AND FIXATION DISPARITY LIMITS FOR PHOTOGRAMMETRY Final Technical Report, Jul. 1964–Aug. 1965
Sandor A. Veres [1965] 46 p refs
(Contract DA-44-009-AMC-641(X))
(AD-625217) CFSTI: HC $2.00/MF $0.50

Fixation disparity is a phenomenon associated with normal binocular vision which causes an observer to perceive a fixated point in space in front of or behind its actual location in physical space. Considering the floating mark settings which are fundamental to photogrammetric measurements, any such settings made by an observer when fixation disparity is present will contain errors of a constant nature which will vary with the viewing conditions and with time. Previous studies of the phenomenon have been of a basic nature and, in general, have not been directly related to the needs of photogrammetry. It is the purpose of this project, therefore, to investigate the effects of fixation disparity on floating mark measurements made under photogrammetric conditions using variable measuring marks, variable targets and variable backgrounds. TAB

N66-18582# Systems Technology, Inc., Hawthorne, Calif.
EFFECTS OF NONLINEARITIES ON HUMAN OPERATOR TRACKING PERFORMANCE: A REVIEW OF THE LITERATURE Final Report, Sep. 1964–May 1965
Richard J. Wasicko and Raymond E. Magdaleno Wright-Patterson AFB, Ohio, AMRL, Oct. 1965 50 p refs
(Contract AF 33(615)-1782)
(AMRL-TR-65-158; AD-626036) CFSTI: HC $2.00/MF $0.50

Available literature on the effects of system nonlinearities on human operator tracking performance is summarized. The reviewed reports include experimental investigations in the technical areas of human engineering and aircraft handling qualities. Pertinent information is presented on experimental details, types of nonlinearities and other experimental variables tested, and primary results; and it is concluded that the general state of knowledge in this area is unsatisfactory. Several nonlinearities (such as actuator rate limiting) important in aircraft manual control systems have not been experimentally investigated, and there is inadequate data on the influence of forcing function characteristics. Author (TAB)

N66-18718# Sandia Corp., Albuquerque, N. Mex.
SAFETY AS A DESIGN FEATURE IN SYSTEMS
A. D. Swain Sep. 1965 14 p refs Presented at the Systems Eng. Conf., Chicago
(Contract AT(29-1)-798)
(SC-R-65-991; CONF-650915-2) CFSTI: HC $1.00/MF $0.50

Designing safety features into systems is a more effective way to reduce accidents than campaigning to make people more careful. Hazards can be drastically and permanently reduced through design action in modifying the hazardous situation, whereas reduction through modifying people is limited and requires continuing reinforcement. Moreover, reinforcement gets exceedingly more difficult to achieve because of the

human tendency to "tune out" stimuli a person comes to consider as noise. Safety in systems is a design problem, one to be resolved by objective engineering techniques.

Author (NSA)

N66-19083 Harry Diamond Labs., Washington, D. C.

AN EVALUATION OF A FLUID AMPLIFIER, FACE MASK RESPIRATOR

Henrik H. Straub and James Meyer (Walter Reed Army Inst. of Res.) *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 309-315 ref (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

A fluid amplifier controlled face mask respirator capable of performing complex respiratory functions is evaluated. The respirator can function, for example, as an assistor for those patients needing support or as a controller in the absence of spontaneous respiration. Results of medical and engineering tests indicate that the respirator performs well on both animals and humans. High expiratory resistance, a characteristic of the device, is overcome with the addition of a specially designed breathing valve that can be eliminated, if necessary, for certain types of patients with respiration difficulties requiring higher-than-normal mean lung pressures. The elimination of moving parts in the respirator itself makes this device extremely reliable, easy to operate, and inexpensive to manufacture.

M.R.W.

N66-19179# Flying Personnel Research Committee, London (England).

A PRELIMINARY ASSESSMENT OF THE LIGHTWEIGHT PRESSURE JERKIN DESIGNED FOR THE VA/EE TYPE 571 AIRCRAFT (T.S.R.2)

J. Ernsting (Roy. Air Force Inst. of Aviation Med.) Jun. 1964 9 p

(FPRC/Memo-211) CFSTI: HC $1.00/MF $0.50

Evaluation methods are described for determining the physiological acceptability of the pressure jerkin, which is made of terylene containing layers and a chloroprene proof nylon bladder. In the preliminary test, a subject wore the jerkin beneath a torso suit, and over an air ventilated suit. The mobility and comfort of the subject while sitting in an ejector seat were assessed at positive breathing pressures of up to 100 mm Hg, and the pressure-volume characteristics were determined for 3 subjects. The limited results suggest that the counterpressure afforded is acceptable, and that the pressure-volume characteristics are within specifications.

N.E.N.

N66-19225*# Texas Univ., Austin. Defense Research Lab.

[STUDIES OF AUDITORY INFORMATION PROCESSING EMPHASIZING THE APPLICATION OF SIGNAL DETECTABILITY THEORY TO THE AUDITORY SENSORY RESPONSES] Semiannual Report, 1 Dec. 1964-31 May 1965 and Quarterly Status Report, 1 Mar.-31 May 1965

Lloyd A. Jeffress and Charles S. Watson 14 Jul. 1965 31 p refs

(NASA Order R-129; Contract Nonr-3579(04))

(NASA-CR-70880) CFSTI: HC $2.00/MF $0.50 CSCL 06B

Status of proposed problems in the psychophysical studies of brightness, signal detection and auditory responses were given. Appended are the results of two specific studies. The first reported the effect of the bandwidth of a noise masker on detection of antiphasic and monaural tonal signals. The signal used was a 500-cps tone with a duration of 150 msec, gated with a rise-fall time of 25 msec. The masker was thermal noise with spectral levels of 50, 45, and 30 dB. The bandwidth masker was varied from 2900 cps to 12.6 cps. The second harmonic of the signal frequency outside the masking noise was detected by subjects when the external bandwidth was narrow. The 1 kc tone was removed from the detection of noise with its spectral level 40 dB down from that of the narrow masker was used. The ability to respond to sensory inputs was reported in the second study. Reaction speed vs accuracy was measured both with and without background noises. It was concluded that when no stress is placed on response time, the observers adopt a strict speed/accuracy strategy, delaying responses only as they become more difficult.

H.S.W.

N66-19267* National Aeronautics and Space Administration, Washington, D. C.

TRAINING DEVICES FOR PREPARING COSMONAUTS FOR OCCUPATIONAL ACTIVITY IN CONTROLLING SPACECRAFT AND THEIR SYSTEMS

N. N. Gurovskiy, V. G. Denisov, A. A. Kuz'minov, and M. M. Sil'vestrov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 1-7 ref (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Complex, specialized, and functional simulators are considered necessary for effective training of cosmonauts and to carry out experiments dealing with spacecraft systems and equipment. A complex simulator is defined as one which permits training all crew members on a given type of space vehicle during all stages of flight, whereas a specialized simulator is designed to develop skills in a whole complex of specific work operations necessary to execute special tasks during space flight. A functional simulator is designed to develop skill in performing work operations involving one type of activity, or to increase the functional capacity of the human operator in performing a specific task. Simulators which can accomplish all three jobs are not considered feasible at the present time. Extended space flights, it is concluded, will require onboard simulation for training the crew to perform vital operations during the prolonged flight.

M.W.R.

N66-19268* National Aeronautics and Space Administration, Washington, D. C.

BASIC PRINCIPLES OF SPECIAL COSMONAUT TRAINING

N. N. Gurovskiy, M. D. Yemel'yanov, and Ye. A. Karpov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 8-11 (See N66-19266 09-04) CFSTI: HC $8.50/MF $3.25

Cosmonaut training is based on several groups of factors, including (1) an understanding of space as an environment which man cannot enter without special protection, (2) building up resistance to the dynamics of space flight caused by rotary and rolling movements, (3) adapting both physically and mentally to the environment of the capsule, and (4) landing procedures. Stressed in relation to cosmonaut training is the use of special psychological methods to determine individual resistance and peculiarities; and the determination of vestibular sensitivity is also considered.

M.W.R.

N66-19269* National Aeronautics and Space Administration, Washington, D. C.

EXPERIMENTAL PSYCHOLOGICAL INVESTIGATION OF COSMONAUT TEAMS

F. D. Gorbov and M. A. Novikov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 12–21 (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Space psychology must be concerned with studies related to the emotional stability of the individual space traveller, ability to cooperate during interdependent activity, and the psychological aspects of living in close proximity with other individuals during periods of protracted "group isolation." The accomplishment of integrated tasks in an experimental situation is discussed, and factors of flight activity are presented to define the job of the cosmonaut. Various tests which simulate flight activities are considered for determining the neuropsychiatric stability of cosmonauts. M.W.R.

N66-19284* National Aeronautics and Space Administration, Washington, D. C.

SOME ASPECTS OF HUMAN ECOLOGY IN CLOSED SYSTEMS WITH RECIRCULATION OF SUBSTANCES

Ye. Ya. Shepelev *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 166–175 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Consideration is given to some of the problems that are inherent to the maintenace of heman activity in closed systems with biological recirculation of substances. Examples are cited which show that human ecology in closed systems can be successfully developed as a general biological discipline only through coordinated efforts which consider each part of the system. Traditional approaches are considered inadequate, and it is suggested that lengthening the daily activity cycle of man be considered for space flights. M.W.R.

N66-19285* National Aeronautics and Space Administration, Washington, D. C.

HYGIENIC INVESTIGATIONS OF COSMONAUT CLOTHING DESIGNED FOR WEAR IN SMALL-SIZED CABIN UNDER SHIRT-SLEEVE MICROCLIMATE CONDITIONS

I. G. Popov, V. I. Krichagin, V. V. Borshchenko, and F. K. Savinich *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 176–184 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Experiments reveal that clothing worn for as long as 30 days without any hygienic treatment has no appreciable effect on the skin. The observed disorders, such as rashes and thin-layer sloughing of the skin on the feet, did not interfere with the efficiency of the subjects or prevent them from carrying out a testing program. Distribution of chlorides between skin and clothing was determined following exposure for 10 and30 days in a heat chamber. Contamination of skin and clothing was relatively small, and determined to a large extent by individual peculiarities of perspiration. The tested clothing showed a high capacity for absorbing chlorides and organic substances; a fabric of 75% cotton-25% rayon showed the highest absorption, while wool showed the least. Wool clothing was shown to have the most unfavorable effects in terms of skin irritation, perspiration, and heat sensation when subjects were exposed to heat. Some attention was given to clothing design. M.W.R.

N66-19286* National Aeronautics and Space Administration, Washington, D. C.

THEORETICAL BASIS FOR THE MICROATMOSPHERE OF INTERPLANETARY SPACECRAFT CABINS AND PROSPECTS OF USING HELIUM-OXYGEN MIXTURES FOR THIS PURPOSE

B. M. Savin *In its* Probl. of Space Biol., Vol. 4 May 1966 p 185–191 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Helium is shown to be a suitable replacement for nitrogen in the microatmosphere of spacecraft cabins. This change does not produce any deliterious effect on the organism or cause any marked changes in physiological processes, although the zone of temperature comfort is about 3–3.5° higher than in ordinary air. It is felt that the low specific gravity of helium should promote a smaller energy expenditure when breathing as well as reduce the amount of energy consumed in circulating the gas mixture through the air conditioning system. The other obvious advantages of helium is that it is more inert and does not form any toxic compounds, it should help reduce the time in going through the airlocks in emerging through space, and it has more heat conductivity than nitrogen. Experimental findings are presented for chicks, mice, and a dog. M.W.R.

N66-19287* National Aeronautics and Space Administration, Washington, D. C.

CYBERNETICS AND SPACE BIOLOGY

N. A. Chekhonadskiy *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 192–200 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Mathematical simulation, biological control, and statistical dynamics are considered in connection with the applications of cybernetics to space biology and medicine. A model for the otolith apparatus, which explains functions of the organ as well as processes of information conversion in the neurons of the reticular formation, is discussed. A problem is described to explain the process which takes place in the human organism due to a radial G-force, and resulting values of permissible G-force action time correlate well with experimental values. Applications of automatic control theory to space biology and medicine are discussed, and the degree of dynamic stability of a spacecraft system is considered in terms of controlling the vegetative functions of man. M.W.R.

N66-19289* National Aeronautics and Space Administration, Washington, D. C.

THE POSSIBILITY OF UTILIZING ELECTRONIC LOGIC CIRCUITS FOR AUTOMATIC MEDICAL MONITORING

V. Ya. Kostikova, R. M. Bayevskiy, A. P. Kalinovskiy, and B. A. Soshin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 213–221 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Technical aspects of the use of electronic logic circuits are considered for automatic monitoring in space biology and medicine. Block designs are presented for a system for analyzing discrete indicators and another for continuously flowing indicators. Details of the analyzer for continuous indicators are shown. A logic circuit consisting of a diode matrix is diagramed, as is an electronic logic circuit for automatic medical control. M.W.R.

N66-19331* National Aeronautics and Space Administration, Washington, D. C.

PHYSIOLOGICAL INVESTIGATIONS OF SPEECH PROCESSES IN CONNECTION WITH THE PROBLEMS OF ESTABLISHING MAN–MACHINE COMMUNICATION BASED ON SPEECH

V. A. Kozhevnikov and L. A. Chistovich *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 574–582 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Development of a speech communication system between man and machine is discussed in terms of inherent problems that exist and possible approaches that can be taken. Use of palatography, the recording contacts between tongue and palate when various sounds are made, is considered as a method to study the articulation phenomenon. An artificial palate sensor is mentioned, as are speech time dynamics and recording methods. Electronic logic circuits can be used to simplify the automatic time variations in the articulation dynamics of speech. M.W.R.

N66-19332* National Aeronautics and Space Administration, Washington, D. C.

SOME METHODS FOR RECORDING AND PROCESSING INFORMATION IN INVESTIGATING THE ARTICULATORY INDICES OF SPEECH

V. S. Shuplyakov *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 583–587 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Electric signals were generated by sensors developed for recording a series of functions performed by a sound-producing apparatus with a sufficient degree of accuracy. The basic device in the series of sensors was a 16 channel pen recorder. A meticulous graphical processing of the recordings was made to establish accurate amplitude-time relationships between signals arriving from different elements of the speech-producing tract, and the reception of various statistical data. A combination of articulation parameters was compared with the acoustic picture of speech pronounced during this time. Automatic time measurements were carried out, and the initial data was processed logically; thereby obtaining complex signals reflecting a whole series of speech properties, and making it possible to study the segmentation of continuously flowing speech sounds based on different combinations of articulation parameters. L.S.

N66-19338* National Aeronautics and Space Administration, Washington, D. C.

SENSORS FOR AUTOMATIC MONITORING OF THE REGULATION OF PHYSIOLOGICAL PROCESSES OF PLANTS IN CLOSED SYSTEMS

V. I. Rozhdestvenskiy and V. G. Chuchkin *In its* Probl. of Space Biol., Vol. 4 Mar. 1966 p 624–636 refs (See N66-19266 09-04) CFSTI: HC $6.50/MF $3.25

Design schemes for sensors that automatically measure the intensity of physiological plant processes in closed systems are presented. Illustrations are given for schemes for measuring the concentration of CO_2 when computing the intensity of photosynthesis in (1) a closed volume, (2) a vessel with air flowing through it, and (3) in a vessel with controlled CO_2 concentration. In addition, a diagram is depicted for a sensor method of measuring the concentrations of K^+ ion in a food solution during the computation of its absorption intensity by the roots of the plant when the concentration of potassium ion is controlled (by varying therate at which the concentrated solution of K^+ is supplied). Other systems for automatically controlling the potassium concentration in feeding solutions with simultaneous recording of the intensity with which the ion and water are absorbed by the plant are also depicted. L.S.

N66-19569# Illinois Univ., Urbana. Dept. of Psychology

BINOCULAR RIVALRY: INDIVIDUAL DIFFERENCES IN ITS FUNCTIONAL RELATIONSHIP TO LUMINANCE AND INSTRUCTIONAL CONDITIONS

Connie Wong Meredith Sep. 1965 51 p refs
(Contract Nonr-1834(39))
(AD-624900) CFSTI: HC $3.00/MF $0.50

Thirty male and thirty female Ss experienced the binocular rivalry phenomenon by viewing stimuli in a modified Wheatstone stereoscope. Principal axis factor analysis indicated that binocular rivalry rate is a single-factor function of the two independent variables, luminance and instructional conditions. An analysis of variance indicated that the effects of both independent variables were significant but that there was no significant interaction. The results were discussed with respect to an S-R model and a neurophysiological model.

Author (TAB)

N66-19585*# Melpar, Inc., Falls Church, Va.

HUMAN PERFORMANCE CONTROL MONITORING SYSTEM Interim Report No. 1, 21 Dec. 1964–30 Sep. 1965

[1965] 120 p refs
(Contract NASw-1085)
(NASA-CR-70708) CFSTI: HC $4.00/MF $0.75 CSCL 06D

Presented are theoretical studies on the development of a mathematical model of a performance control and monitoring system and, development of techniques for prediction and estimation. Applications of trainable logic were developed in the areas of computation and control. In the area of computation, Monte Carlo type methods and the solution of simultaneous equations were investigated using statistical switch techniques. Three application problems are presented, emphasizing slightly different aspects of performance control systems. H.S.W.

N66-19599*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CRITERIA FOR THERMAL REGULATION FOR MANNED SPACECRAFT CABINS

Robert W. Johnson Washington, NASA, Mar. 1966 23 p refs
(NASA-TN-D-3349) CFSTI: HC $1.00/MF $0.50 CSCL 06K

Use of man in space for observational, analytical, and experimental missions requires that a comfortable and as nearly stress-free environment as possible be provided. By use of results of engineering and physiological investigation, conditions are proposed for thermal comfort in spacecraft shirt-sleeve environments. Air, cabin-wall, and skin temperatures are investigated for a range of clothing and interrelated to obtain essentially sweat-free conditions. This criterion establishes a basis for minimum individual stress and efficient design of atmospheric subsystems. Design methods are recommended in order to apply the minimal sweat condition to a wide range of work and rest levels. Measurements are discussed that may be used to evaluate comfort conditions, taking into account airflow rate and temperature, surface temperature, and metabolic rates. Author

N66-19635*# Hahnemann Medical Coll. and Hospital, Philadelphia, Pa. Dept. of Medicine.

EXTERNAL BIOELECTRODES: A BATTERY SUBSTITUTE FOR BIOLOGICAL TELEMETRY SYSTEMS Final Report, Period Ending 28 Feb. 1966

Frank C. Tye and Luther W. Reynolds [1966] 28 p refs
(Grant NGR-39-021-002)
(NASA-CR-70924) CFSTI: HC $2.00/MF $0.50 CSCL 06B

The power output of various electrode pairs, in saline and on the skin, have been reported. Probable reasons for variations in the power output have been included. A basic minimal

power output for the Mg–Ag electrode pair has been established and found to be more than adequate for telemetry systems. Electrodes have proved to be reliable over long periods of time without special maintenance. Author

N66-19674# Illinois Univ., Urbana. Electrical Engineering Research Lab.
A STUDY OF A FAMILY OF COMPLEX SYSTEMS, AN APPROACH TO THE INVESTIGATION OF ORGANISMS' BEHAVIOR
Crayton C. Walker Jun. 1965 271 p refs *Its* Tech. Rept.-5 (Grants AF-AFOSR-7-64; NSF GP-700)
(AFOSR-65-1713; AD-624864) CFSTI: HC $6.00/MF $1.50

A family of complex systems is examined which is defined with reference only to theoretically basic characteristics of the systems' parts and their interrelationship. The systems considered are intricate structures built up of simple electrical devices called elements which interact with one another. Each element has two possible element states, with its present state determined from states of other elements and from its previous state by a fixed transformation. Given a particular transformation, a system is constructed by taking 100 elements embodying that transformation and joining them at random. The system's behavior is studied by examining its cycles under operation. Then a different system is built using the same elements and the sampling of behavior repeated. Systems are compared, and it is found that for many transformations, details of structure are evidently unimportant in the occurrence of certain types of behavior. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-18495# Naval Ammunition Depot, Crane, Ind.
THE PRODUCTION OF VISIBLE LIGHT BY THE THORIA-CERIA MANTLE; PHYSICAL CHARACTERISTICS AND A PROPOSED THEORY OF THE OCCURRING MECHANISMS AND PROCESSES
Duane M. Johnson 15 Jul. 1965 24 p refs
(RDTR-66; AD-625008) CFSTI: HC $1.00/MF $0.50

An explanation of the production of visible light by a thoria-ceria mantle is presented. It is proposed that the thoria acts as a chemical catalyst and localizes the exothermic reaction within the mantle structure. Author (TAB)

N66-18498# Space-General Corp., El Monte, Calif. Artificial Biosystems Lab.
RESEARCH AND DEVELOPMENT PROGRAM ON AN ELECTROCHEMICAL ADAPTIVE SYSTEM FOR PATTERN RECOGNITION Quarterly Progress Report
Nov. 1965 18 p ref
(Contract NOw-65-0470-d)
(QPR-2; AD-625895) CFSTI: HC $1.00/MF $0.50

The objective of this phase of investigation was the continued study of photostimulation of the passive surface of iron in nitric acid. Although stimulation by light of a single passive iron electrode has been achieved, investigation must proceed further before the longer-range goal is attained: a practical prototype of a radiant imaging input system for an adaptive electrochemical machine. TAB

N66-18501# Naval Research Lab., Washington, D. C.
THE PLATE MATERIALS OF THE LEAD–ACID CELL. PART I: ANODIC OXIDATION OF THE BASIC SULFATES OF LEAD
Deanne Burbank 23 Nov. 1965 17 p refs
(NRL-6345; AD-625693) CFSTI: HC $1.00/MF $0.50

The basic lead sulfates $PbO \cdot PbSO_4$, $3PbO \cdot PbSO_4 \cdot H_2O$, and $4PbO \cdot PbSO_4$ were prepared by reacting PbO and dilute H_2SO_4. The crystalline phases were identified by X-ray diffraction patterns, and electron microscope examination showed all three to be prismatic needles. The three basic sulfates were oxidized anodically in dilute H_2SO_4, and X-ray diffraction showed that each transformed to β-PbO_2. The pellet made from $4PbO \cdot PbSO_4$ was mechanically strong, and the transformation to PbO_2 was largely metasomatic after the original crystals of the basic sulfate. The three anodic preparations were examined in the electron microscope and showed the presence of prismatic and nodular particles of PbO_2.
Author (TAB)

N66-18504# Monsanto Research Corp., Dayton, Ohio.
STUDIES OF LOW-TEMPERATURE OXIDATION REACTIONS Annual Progress Report, Oct. 1, 1964–Sep. 30, 1965
L. Parts and J. T. Miller, Jr. 6 Dec. 1965 60 p refs
(Contract Nonr-3977(00))
(APR-3; AD-625307) CFSTI: HC $3.00/MF $0.75

Nitrosonium nitrate, $NO^+NO_3^-$, is formed upon the oxidation of nitric oxide in certain hydrocarbon solutions at cryogenic temperatures. The infrared spectrum of this compound was studied at temperatures ranging from 79° to 205° K. Low-temperature (77°–90° K) oxidative nitration of isobutylene and subsequent oxidation of the unstable product with N_2O_4 at 273° K yield 2-nitratoisobutyraldehyde and 2-nitratoisobutyric anhydride. Nitrosonium nitrate may be transitory intermediate in the reaction of N_2O_4 with olefins at about 273° K. Tetraflurohydrazine was found to react with a number of inorganic and organometalloid compounds. Most of these reactions occur only above 243° K. This suggests that the difluoramino radical, present in equilibrium with tetrafluorohydrazine in this temperature range, is the reactive species. TAB

N66-18515# Colorado Univ., Boulder.
RUBBER RESEARCH: THE SYNTHESIS OF SPECIAL FLUORINE-CONTAINING MONOMERS Semiannual Progress Report, 1 Apr.–1 Oct. 1965
J. D. Park and J. R. Lacher 10 Oct. 1965 42 p refs
(Contract DA-19-129-QM-1926)
(SAPR-3; AD-625935) CFSTI: HC $2.00/MF $0.50

Fluorine-containing compounds are being studied in order to synthesize monomers from which to obtain elastomers that will be resistant to chemicals and gasoline. Part I on highly fluorinated cyclobutene series: New olefins and nonconjugated diolefins are being studied as possible candidates for polymer evaluation as well as intermediates for synthesis of other monomers containing a heteroatom or atoms. Intermediates have been prepared that are bicyclobutenyl derivatives. The reactions of diiodo butene are being studied. Part II on highly fluorinated cylopentenes: The studies concern nucleophilic displacement reactions. Grignard reagents, and synthesis of vinyl heptacyclopentene systems. TAB

N66-18554# Kansas Univ., Lawrence. Dept. of Chemistry.
MECHANISM OF INORGANIC REACTIONS Final Scientific Report
Reynold T. Iwamoto [1965] 6 p refs
(Grants AF-AFOSR-61-8; AF-AFOSR-220-63)
(AFOSR-65-1913; AD-626137) CFSTI: HC $1.00/MF $0.50

A summary is given of studies concerning the use of nonaqueous solvents and of electrodes, in place of either the oxidant or the reductant, to obtain information fundamental to a better understanding of the mechanism of inorganic oxidation–reduction reactions. A list of publications generated under the contract is included. TAB

N66-18566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF SEMICONDUCTOR CHEMISTRY
A. V. Novoselova 8 Dec. 1965 16 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 8, 1964 p 71–76
(FTD-TT-65-1056/1+2+4; AD-625146) CFSTI: HC $1.00/MF $0.50

Topics include synthesis of crystalline inorganic semiconductor materials; nature of the chemical bond in semiconductors; obtaining semiconductors with pre-determined properties; semiconductors not of the sphalerite crystallochemical group. TAB

N66-18586# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
LIQUID-GAS INTERFACES STUDIED ON THE BASIS OF THE CLASSICAL SURFACE TENSION THEORY AND INTERMOLECULAR FORCE MODELS Technical Report No. 15
Barry Flachsbart and Max Anliker Sep. 1965 131 p refs
(Contract Nonr-225(30); Grant NSF GK-47)
(SUDAER-245; AD-625715) CFSTI: HC $4.00/MF $1.00

Liquid-gas interfaces are studied from two viewpoints. The first method uses the classical surface tension model of the interface. The differential equation defining the equilibrium shape of the interface relates the surface tension with the pressure difference across the interface. The boundary conditions for the equation assume that the contact angles (the angles the liquid forms with the container walls) are constant and independent of the body forces. An iterative method for finding the equilibrium shape is developed, for the case of small body forces. The method is used in two cases and compared with results of other methods. The stability of the interface is investigated for a two-dimensional layer spread over a segment of a rigid cylinder with rigid radial walls. The eigenfunctions of the vibrations of layers of nonuniform depth are expanded in terms of the eigenfunctions for the layers of uniform depth. Approximations are made by truncating the series. The coefficients are obtained by minimizing the mean square error along the interface. The results are given in the form of a relationship between a dimensionless stability parameter and the angle between the radial walls for the case of limiting stability. A comparison of the approximate results with known solutions shows good agreement. TAB

N66-18588# Weizmann Inst. of Science, Rehovoth (Israel).
PRESSURE INDUCED SHIFTS OF HYDROGEN FLUORIDE LINES DUE TO NOBLE GASES
J. H. Jaffe, A. Rosenberg, M. A. Hirshfeld, and N. M. Gailar (Tennessee Univ.) Jun. 1965 22 p refs Prepared in cooperation with Tennessee Univ. *Its* Tech. Note No. 1
(Contract AF 61(052)-838)
(AFCRL-65-782; AD-626202) CFSTI: HC $1.00/MF $0.50

The pressure induced shifts of hydrogen fluoride 1-0 and 2-0 band lines due to noble gases were measured. The shifts have the same general features as those observed with HCl, but they display certain peculiarities that were interpreted by using a phase-shift theory with a particular collision model. Author (TAB)

N66-18597# Birmingham Univ. (England). Dept. of Chemistry.
MICROWAVE SPECTROSCOPIC STUDIES OF MOLECULES
J. Sheridan 31 Jan. 1965 14 p
(Grant AF-EOAR-62-1)
(SR-3; AD-625497) CFSTI: HC $1.00/MF $0.50

Detailed spectroscopic studies are summarized for acetyl acetylene and trifluoroethylene. For the first of these, assignments and barrier-heights were found for three isotopic forms and very consistent results derived. For trifuloroethylene, an exhaustive study of vibrationally excited molecules was made, leading to identification of spectra for carbon-13 species in natural concentration. When these were combined with data for the deuterated species, all possible microwave structural information for the molecule was derived. Dipole moment studies of these substances are also reported with preliminary work on other molecules. Computation procedures in spectral analysis were developed. Author (TAB)

N66-18614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINMENT OF DISPERSION METAL POWDERS BY ELECTRO-REDUCTION OF DIFFICULT SOLUBLE COMPOUNDS IN MOLTEN MEDIA
I. P. Chernobayev, L. N. Antipin, and M. O. Loshkar'ov 28 Sep. 1965 12 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 5, 1963 p 618–623
(FTD-TT-65-904/1+2+4; AD-625781) CFSTI: HC $1.00/MF $0.50

The possibility of obtaining metal powders of Co, Ni, Fe, Mo, V, and others from difficultly reducible oxides with the aid of intermediate reagents in molten electrolyte, is shown. The dependence of current output upon temperature and current density during the reduction of iron oxides is explained. It was established that the powders so obtained have, basically, a dendritic form and that the dimensions of the particles are in the range of 10–30 microns, thus making them suitable for the manufacture of ceramet objects. Author (TAB)

N66-18627# General Precision, Inc., Little Falls, N. J. Aerospace Group.
HIGH-TEMPERATURE-RESISTANT PHTHALOCYANINE POLYMERS Final Report, Nov. 1, 1964–Oct. 31, 1965
P. Jaffe 1 Nov. 1965 95 p refs
(Contract Nobs-92081)
(AD-625680) CFSTI: HC $3.00/MF $0.75

A method was developed for the large-scale preparation and subsequent purification of dichlorosilicon phthalocyanine. This important monomer intermediate was then converted to various derivatives, including dihydroxysilicon phthalocyanine, diisocyanatosilicon phthalocyanine and dithiocyanatosilicon phthalocyanine. The chemistry of the metallophthalocyanine pseudohalides showed anomalous behavior. Treatment of these monomers under a variety of reaction conditions with bis (hydroxymethyl) carborane gave similar but not identical bis (oxymethyl) carboranesilo xyphthalocyanine condensation

copolymer intermediates. Five distinct methods for the synthesis of this copolymer system were developed. Depending on the method of synthesis, the various bis (oxymethyl)carborane- siloxyphthalocyanine copolymer products showed selective and good solubility in benzene, toluene, amines or other solvents. Various polymer chain extension and cross-linking techniques were investigated. A by-product of this work was the development of a route to poly (carboranylethyl) etylenes. Thermal stability tests were run on some model compounds and on the 3:2 bis (hydroxymethyl) carborane-siloxyphthalocyanine condensation copolymer. The heat resistance of PcAlCl (540C) is superior to that of $PcSiCl_2$ and PcTiO (450C) and the copolymer intermediate is stable to about 360° C in air. Author (TAB)

N66-18644# IIT Research Inst., Chicago, Ill. Technology Center.

DETERMINATION OF THE STRUCTURE OF O_3F_2 Final Technical Report, Oct. 1, 1961–Sep. 30, 1964

Richard G. Maguire 2 Jun. 1965 99 p refs
(Contract AF 49(638)-1091)
(IITRI-C206-13; AFOSR-65-1731; AD-625077) CFSTI: HC $3.00/MF $0.75

The objective of this program was to study the molecular structure of trioxygen difluoride, O_3F_2. To accomplish this objective the following properties were measured: surface tension, viscosity, dielectric constant, paramagnetic susceptibility, specific susceptibility, molar magnetic moment, electron paramagnetic resonance, nuclear magnetic resonance, and infrared spectra. The structure of O_3F_2 is not clearly defined. There is evidence to support the presence of O_2F and OF radicals. There is evidence to support the possibility that O_3F_2 is a trimer at least in the liquid state. O_3F_2 is not a compound of ozone. A linear molecular configuration is not possible. Author (TAB)

N66-18653# Army Missile Command, Huntsville, Ala. Aerodynamics Branch.

MICROWAVE (ROTATIONAL) SPECTROSCOPY Bibliography

James E. Wollrab 4 Aug. 1965 106 p refs
(RD-TM-65-14; AD-625846) CFSTI: HC $4.00/MF $0.75

The references listed in the bibliography include a majority of the important papers and books that are related to the development of microwave spectroscopy. General references relating to the basic concepts of rotational and, in a limited way, vibrational spectroscopy are also included. The references have been placed under specific topic headings whenever possible. A chronological order under these headings is maintained. Author (TAB)

N66-18683# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

RADIOCHEMICAL STUDIES ON THE EXTRACTION AND STABILITY OF METAL CHELATES AND ON THE SEPARATION OF METAL SALTS BY EXTRACTION CHROMATOGRAPHY [BADANIA RADIOCHEMICZNE NAD EKSTRAKCJA I TRWALOSCIA CHELATOW ORAZ NAD ROZDZIELANIEM METALI METODA CHROMATOGRAFII EKSTRAKCYJNEJ]

Ignacy Stronski 1965 139 p refs In POLISH; ENGLISH summary
(Rept.-427/C) CFSTI: HC $4.00/MF $1.00

The extraction processes of some metal ions by means of chloroform solution of quadridentate, aromatic Schiff bases, and 8-mercaptoquinoline (thioxine) was investigated by the radioactive indicator method. The dissociation constants of some Schiff bases were determined spectrophotometrically, and the stability constants of nickel and uranium chelate complexes established by the graphical method of Dryssen and Sillen. By means of thiooxine labelled with isotope ^{35}S, the distribution coefficients of these compounds in the systems electrolyte–organic solvent were determined. Using radioactive isotopes, the optimum conditions of separation of various mixtures of transition and actinide metal salts by extraction chromatography in the system tri-n-butylphosphate–hydrochloric acid, tri-n-octylphosphine oxide–mineral acid, and tri-n-octylamine–electrolyte, were described. Author

N66-18693# Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). Centraal Laboratorium.

THE OZONOLYSIS OF DIPHENYL AND THE THREE TERPHENYL ISOMERS [DE OZONOLYSE VAN DIFENYL EN DE DRIE ISOMEREN VAN TERFENYL]

G. de Vries Brussels, EURATOM, 1965 10 p refs In DUTCH
(Contract EURATOM-110-61-1 ORGN)
(EUR-2272.n)

A method which yields reproducible results has been developed for ozonization. The speed of the reaction of ozone with the three terphenyl isomers in chloroform and methylene chloride is fixed at −20°C. The difference in reaction speed between the isomers is too small to be used as a basis for a method of analysis. In contrast with the result stated in the literature, the reaction of ozone with meta-terphenyl at −20°C, whether or not in the presence of ethanetetracarbonitrile, is a diminishing reaction. Author (NSA)

N66-18700# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

METHOD OF GAS-CHROMATOGRAPHIC ANALYSIS OF POLYPHENYLS IN LITHIUM CHLORIDE COLUMNS AND ITS APPLICATION TO THE CONTROL AND PREPARATION OF PURE QUATERPHENYL ISOMERS [MESSA A PUNTO DI UN METODO DI ANALISI DEI POLIFENILI PER GAS-CROMATOGRAFIA SU COLONNE A CLORURO DI LITIO E APPLICAZIONE NEL CONTROLLO DELLA PREPARAZIONE DI ISOMERI PURI DEI QUATERFENILI]

C. Bordonali and C. Patimo Jun. 1965 23 p refs In ITALIAN
(RT/CHI(65)-25)

A method of gas-chromatographic analysis on lithium chloride columns is described, together with its application on the purity control of the quaterphenyl isomers. The method used to prepare the pure isomers of the quaterphenyls was also then examined. Author (NSA)

N66-18710# Iowa State Univ. of Science and Technology, Ames.

THE PREPARATION OF VANADIUM METAL BY THE ALUMINUM REDUCTION OF VANADIUM PENTOXIDE

William Edward Krupp (M.S. Thesis) Feb. 1965 65 p refs
(Contract W-7405-ENG-82)
(IS-T-40) CFSTI: HC $3.00/MF $0.75

A process is described for preparing high purity vanadium metal in kilogram quantities. Vanadium pentoxide is

bomb-reduced with aluminum metal in the presence of iodine, which acts as a thermal booster. The resulting vanadium–aluminum alloy is consolidated by arc casting and purified by electron beam melting. Vanadium metal containing a level of impurities equivalent to that obtained by the crystal-bar iodide process was consistently produced in yields of 80%. Use of this metal to replace the crystal-bar refining step resulted in a considerable cost reduction. Author (NSA)

N66-18719# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Departement des Recherches Minières.
COMPUTER PROCESSING OF γ SPECTRA. APPLICATION TO THE DETERMINATION OF MIXED NATURAL OR ARTIFICIAL RADIOELEMENTS [TRAITEMENT PAR ORDINATEUR DES SPECTRES γ. APPLICATION AU DOSAGE DE MELANGES DE RADIOELEMENTS NATURELS OU ARTIFICIELS]
Rene Coulomb, Marcel Goldsztein, and Jean-Claude Schiltz Aug. 1965 66 p In FRENCH
(CEA-R-2850)

A program, written in Fortran II for IBM 7094 II, permitting resolution by means of least squares of a mixture of natural or artifical radioelements, is described. The spectra are processed in measurement groups, making up a homogeneous study, which comprise standards and samples. This highly versatile program may either ensure the processing of a great number of daily analyses, or be used pending development of radiochemical methods. The numerical or graphical controls, error computations, and the printing of results in clear and legible form were multiplied. In spite of this, the calculation times are exceedingly short. Several independent studies which include about sixty spectra may be processed in less than five minutes. Author (NSA)

N66-18732# California Univ., Berkeley. Lawrence Radiation Lab.
SPECTROSCOPIC INVESTIGATION OF HIGH TEMPERATURE SPECIES ISOLATED IN INERT GAS MATRICES
G. D. Brabson (Ph.D. Thesis) Aug. 1965 131 p refs
(Contract W-7405-ENG-48)
(UCRL-11976) CFSTI: HC $4.00/MF $1.00

The matrix isolation technique was applied to three systems, and the isolated species were studied by visible-ultraviolet and infrared spectroscopy. The 3 systems included Hg, and S_2 in Ne, Ar, Kr, Xe, and N_2, and graphite vapor in Ar, Kr, and N_2. Mercury spectra were found to be shifted to shorter wavelength by 940, 1270, 775, 10 and 845 cm^{-1}, respectively. Fluorescent experiments on S_2 showed that vibrational motion is rapidly quenched by the matrix; the strongest bands belong to the (O,v'') progression. The spectrum of C_3 was observed, but spectra attributable to C_2 were not found in the region from 2000 to 12,000 Å. NSA

N66-18748# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
BEHAVIOUR OF KRYPTON AND XENON IN URANIUM METAL. RELEASE OF KRYPTON AND XENON FROM METALLIC URANIUM
Ryukichi Nagasaki and Satoru Kawasaki May 1965 20 p refs
Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 6, no. 11, 1964 p 646–655
(AERE-TRANS-1034) HMSO: 4s

The diffusion coefficients of Kr and Xe in irradiated U are considered using the experimental results obtained and the diffusion equations, and the factors influencing the coefficients are discussed. When the sample was heated under inert gas atmosphere, the apparent diffusion coefficient increased. For highly irradiated samples, the diffusion coefficient was smaller than in less highly irradiated samples. When the sample was heated in an inert gas atmosphere, the release of gases was suddenly increased at the transformation temperature of the samples, and the gas release was also increased by thermal cycling. It is very probable that the gas bubbles migrate as a result of the surface diffusion of the matrix atoms. NSA

N66-18751# Argonne National Lab., Ill.
BEHAVIOR OF ZIRCONIUM DICHLORIDE IN MOLTEN MIXTURES OF ALKALI AND ALKALI EARTH METALS [POVEDENIE DVUKHLORISTOGO TSIRKONIYA V RASPLAVLENNYKH SMESYAKH KHLORIDOV SHCHELOCHNYKH I SHCHELOCHNOZEMEL'NYKH METALLOV]
I. N. Sheiko and V. T. Barchuk Oct. 1965 8 p refs Transl. into ENGLISH from Ukrain. Khim. Zhur. (Kiev), v. 30, issue 6, 1964 p 577–581
(ANL-TRANS-233) CFSTI: HC $1.00/MF $0.50

The behavior of $ZrCl_2$ was studied in the following molten systems: KCl–LiCl, KCl–NaCl, NaCl–$CaCl_2$, KCl–$MgCl_2$, NaCl–$MgCl_2$, NaCl–$BaCl_2$, NaCl–$AlCl_3$, and KCl–NaCl–$ZrCl_4$. It was found that $ZrCl_2$ does not suffer changes in the melts up to 400° C. Temperature increase above 400° C leads to a noticeable disproportionation and to an increase of the metal content in the melt. The disproportionation process depends on the nature of the melt and on the temperature and duration of the experiment. It was found that $ZrCl_2$ is practically insoluble in all investigated melts and is present in an equilibrium with the metal on particles produced by the disproportionation of $ZrCl_2$. The amount of $ZrCl_2$ in the melt depends essentially on the temperature and on the stability of the suspension of metallic Zr. Author (NSA)

N66-18756# Kernforschungsanlage, Juelich (West Germany). Institut für Reaktorwerkstoffe.
PHYSICO-CHEMICAL ANALYSIS METHODS FOR STUDY OF REACTOR MATERIALS AND NUCLEAR FUELS [PHYSIKALISCH-CHEMISCHE ANALYSENMETHODEN ZUR UNTERSUCHUNG VON REAKTORMATERIALIEN UND KERNBRENNSTOFFEN]
H. Nickel Jan. 1965 142 p refs In GERMAN
(JUL-216-RW)

Several methods were tested with respect to their applicability to the studies of solids used in reactor technology. Results showed that activation analysis is at least equal to other commonly used methods. The hot extraction of oxygen in vacuum gave satisfactory results. The physical-chemical processes in boron and iron containing graphite electrodes in arc excitation and their influence on the spectrochemical results were determined in the study of the quantitative analysis. The X-ray diffraction method was found to be well suited to the quantitative analysis of U–Th mixed oxides. 211 references are cited. NSA

N66-18768# California Univ., Berkeley. Lawrence Radiation Lab.
TEMPERATURE DEPENDENCE OF TRANSVERSE RELAXATION TIME OF OXYGEN-17 IN AQUEOUS SOLUTIONS CONTAINING CUPRIC AND CHROMOUS IONS

Charles Waymond Merideth (Ph.D. Thesis) Jan. 1965 102 p refs
(Contract W-7405-ENG-48)
(UCRL-11704) CFSTI: HC $4.00/MF $0.75

The temperature dependence of the transverse relaxation time, T_2, of oxygen-17 in aqueous solutions containing cupric and chromous ions was studied in the temperature range −59.6 to 150°C. The low-temperature region was rendered accessible by using eutectic solutions of water and perchloric acid (40.7% $HClO_4$ by wt). As a result of this study, lower limits were set for both the rate of exchange of water molecules from the first coordination sphere of the paramagnetic ions and the rate of inversion of the distorted octahedra of water molecules surrounding the metal ions. The enthalpies of activation for these exchange processes are given. The rate constants for the exchange are observed to be larger than those reported for other plus two ions of the iron group. These large rate constants have been interpreted in terms of the Jahn-Teller distortion of the octahedra of water molecules around the hydrated cupric and chromous ions. In the case of the cupric-water system, the observed temperature dependence of T_{2p} for oxygen-17 is seen to parallel that for the T_{2e} of the paramagnetic electron of the cupric ion. An explanation of this rather striking phenomenon is given by proposing that T_{2e} relaxation for the paramagnetic electron is a function of the chemical exchange process detected by the nuclear magnetic resonance measurements. The chemical shift of the resonance of the bulk water molecules as a result of the presence of the paramagnetic ions was measured in both cases. This represents the first measurement of the shift for the oxygen-17 nuclear resonance in the presence of cupric ions and was made possible only by observing the system at elevated temperatures. The shift measured for oxygen-17 in the presence of chromous ion is shown to be in good agreement with the value reported in the literature. From these chemical shift measurements the average coupling constants for the interaction of the oxygen-17 nucleus and the paramagnetic ions were calculated. Author (NSA)

N66-18774# Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF GALLIUM IN HIGH-PURITY PLUTONIUM METAL
Ross D. Gardner, Charles T. Apel, and William H. Ashley 27 Mar. 1965 13 p refs
(Contract W-7405-ENG-36)
(LA-3248) CFSTI: HC $1.00/MF $0.50

The rhodamine B method for the spectrophotometric determination of gallium was modified and applied to the determination of trace amounts of gallium in high-purity electrolytic plutonium metal. In this method the plutonium is dissolved in hydrochloric acid and the chlorogallate–rhodamine B complex is extracted into a 3:1 mixture of chlorobenzene and carbon tetrachloride without any preliminary separation of the plutonium. The absorbance of the extract is measured at 562 mμ. Forty-two determinations made on plutonium solutions containing from 0.5 to 100 ppm of gallium showed a standard deviation of 2% relative or 0.1 ppm, whichever was larger. Some care is necessary to assure that the volume and acidity of the aqueous phase is reproduced each time, but the manipulations are simple and little time is required. Interference from plutonium and from other elements commonly found in high-purity plutonium metal was found to be negligible. Author (NSA)

N66-18778# Los Alamos Scientific Lab., N. Mex.
THE SOLUBILITY OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. V: REVISIONS TO THE TANTALUM STUDY
D. F. Bowersox and J. A. Leary 27 Jul. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3338) CFSTI: HC $1.00/MF $0.50

The solubility of Ta in liquid Pu was redetermined over the temperature range 750 to 950°C. The solubility is given by the equation $\log N_{Ta} = 0.7690 - 3.938 \times 10^3 T^{-1}$, where N_{Ta} is the solubility of Ta expressed as atomic fraction, and T is the temperature in degrees Kelvin. The solubility increased from 644 ppm Ta (by weight) at 750°C to 2667 ppm Ta at 950°C. Author (NSA)

N66-18784# Los Alamos Scientific Lab., N. Mex.
THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. VI: RHENIUM
D. F. Bowersox and J. A. Leary 3 Sep. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3359) CFSTI: HC $1.00/MF $0.50

The solubility of Re in liquid Pu was studied over the range 700 to 950°C from 0 to 4 percent Re. The apparent solubility is given by the equation $\log N_{Re} = 0.1945 - 1.960 \times 10^3 T^{-1}$, where N_{Re} is the solubility of Re expressed as the mole fraction, and T is the temperature in degrees Kelvin. The solubility increased from 1.23 percent Re (by weight) at 700°C to 3.19 percent Re at 950°C. Author (NSA)

N66-18808# Los Alamos Scientific Lab., N. Mex.
METHODS FOR THE DETERMINATION OF PLUTONIUM IN SPENT REACTOR FUELS, PLUTONIUM METAL, ALLOYS AND COMPOUNDS
Charles F. Metz and Glenn R. Waterbury [1965] 27 p refs Presented at IAEA Symp. on Nucl. Mater. Management, Vienna
(Contract W-7405-ENG-36)
(LA-DC-6938; CONF-650803-6; SM-67/33) CFSTI: HC $2.00/MF $0.50

A review is presented of the analytical methods for Pu which are most widely used in the U. S. in Pu production processes and in research and development programs on Pu metal, alloys, and compounds. NSA

N66-18809# Los Alamos Scientific Lab., N. Mex.
THE X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF PLUTONIUM IN URANIUM–PLUTONIUM–MANGANESE ALLOYS
E. A. Hakkila, R. G. Hurley, and G. R. Waterbury 1 Mar. 1965 15 p refs
(Contract W-7405-ENG-36)
(LA-3333) CFSTI: HC $1.00/MF $0.50

Plutonium in uranium–plutonium–manganese alloys is determined without chemical separation using an X-ray fluorescence spectrographic method. The ternary alloy is dissolved in hydrochloric acid, thorium is added to serve as the internal standard, and the solution is irradiated using a tungsten target X-ray tube. The ratios of the intensities of the $L\alpha_1$ X-ray lines for thorium and plutonium are measured. The method is applicable to the determination of 10 to 50% of plutonium with a relative standard deviation of approximately 1.3% for samples containing no greater than 50% of uranium. Greater uranium concentrations result in selective enhancement of the thorium internal standard line, requiring separate calibration curves for samples containing greater

than 50% of uranium. Sulfuric acid is added to samples and standards to minimize absorption effects. Author (NSA)

N66-18811# California Univ., Livermore. Lawrence Radiation Lab.
VOLATILITIES OF THE FISSION PRODUCT AND URANIUM OXIDES
Ray G. Bedford and Donald D. Jackson 20 Jan. 1965 39 p refs
(Contract W-7405-ENG-48)
(UCRL-12314) CFSTI: HC $2.00/MF $0.50

Free energies of oxides were compiled and used to calculate at several temperatures from 500 to 2500°K the equilibrium abundances of the gaseous oxides of the elements between atomic numbers of 32 and 62, and of uranium. The equivalent pressures of fission products are plotted for 1500 and 2500°K and oxygen pressures 1 and 10^{-10} atm. NSA

N66-18817# Michigan Univ., Ann Arbor.
POLAROGRAPHIC REDUCTION OF ADENINE 1-N-OXIDE
Charles R. Warner and Philip J. Elving 8 Mar. 1965 24 p refs
(Contract AT(11-1)-1148)
(COO-1148-95) CFSTI: HC $1.00/MF $0.50

Adenine 1-*N*-oxide gives a fundamental pattern of three polarographic waves over the pH range of 1.4 to 5.6; above pH 6, the pattern is obscured by the prior background discharge. The first wave, which arises from the two-electron reduction of the *N*-oxide to adenine, is pH-dependent; the shape of the wave is distorted by the marked decrease in its slope with increasing pH, until at about pH 4, it is difficult to distinguish between it and the next wave. The second wave, which shows a pH-dependence and general behavior identical to those of adenine itself, is due to the further six-electron reduction of adenine, probably to an aminoimidazole, plus some reduction of hydrogen ion through a catalytic process involving one or more of the adenine species and their reduction products. The third wave is due to a catalytic hydrogen evolution, which again involves the adenine species and their reduction products. Author (NSA)

N66-18819# Iowa State Univ. of Science and Technology, Ames.
A STUDY OF TUNGSTEN (II) AND TUNGSTEN (III) BROMIDES
Gary Austin Murray (M.S. Thesis) Feb. 1965 50 p refs
(Contract W-7405-ENG-82)
(IS-T-5) CFSTI: HC $2.00/MF $0.50

Tungsten (II) bromide was prepared by aluminum reduction of tungsten (V) bromide in a temperature gradient of 550/300°C. The reaction was performed in a sealed, evacuated Vycor tube. Final heat treatments of the product yielded tungsten (II) bromide in good yields and purity. The bromide, formed a hydrate upon exposure to air and eventually underwent hydrolysis. An x-ray diffraction powder pattern of tungsten (II) bromide hydrate was compared to an x-ray diffraction powder pattern of molybdenum (II) bromide hydrate, the structure of which is known. The two hydrates were found to be isostructural, and the existence of the polynuclear tungsten halide ion, $(W_6Br_8)^{4+}$ was confirmed. Tungsten (II) bromide is soluble in absolute ethanol and from this solution a diethanolate was obtained, which was formulated by analytical and molecular weight determinations as $W_6Br_8)Br_4(C_2H_5OH)_2$. This also supports the existence of the polynuclear tungsten halide ion. Spectral work on tungsten (III) bromide in absolute ethanol showed that reduction of tungsten (III) bromide to tungsten (II) bromide occurs in short periods of time. The solution chemistry of the former compound was greatly hampered by this fact. A study of the kinetics of the formation of tungsten (III) bromide by the reaction of liquid bromine and tungsten (II) bromide indicated that the reaction is zeroth order. The rate of reaction appears to be dependent upon factors such as particle size, surface area, surface conditions, etc. Author (NSA)

N66-18839# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF COMPLEXES OF CURIUM AND EUROPIUM USING SOLVENT EXTRACTION [IZUCHENIE KOMPLEKSOOBRAZOVANIYA KYURIYA I EUROPIYA EKSTRAKTSIONNYM METODOM]
I. Stary 1965 8 p refs In RUSSIAN
(JINR-P-2001)

On the basis of an investigation of extraction of curium and europium with thenoyltrifluoracetone in benzene, the extraction constants have been determined (log K = −7.30 for Cm and log K = −7.18 for Eu). Further, composition and stability constants were determined for complexes of curium and europium with tartaric acid (log β_2 = 6.84 for Cm and log β_2 = 6.79 for Eu), with oxalic acid (log β_2 = 8.8 and log β_3 = 12.1 for both Cm and Eu); with nitrilotriacetic acid (log β_2 = 20.13 for Cm and log β_2 = 20.42 for Eu), with ethylenediaminetetraacetic acid (log β_1 = 17.10 for Cm and log β_1 = 17.34 for Eu) and with 1,2-diaminocyclohexanetetraacetic acid (log β_1 = 18.35 for Cm and log β_1 = 18.51 for Eu). From the results obtained, it follows that the stability of complexes of curium is higher than those of americium, but it is lower than the stability of corresponding complexes of europium. Author (NSA)

N66-18853# Los Alamos Scientific Lab., N. Mex.
KINETIC STUDIES ON EXTRACTION OF EUROPIUM BY LITHIUM AMALGAM AND COMPARISON TO REMOVAL BY ELECTROLYSIS
E. I. Onstott and John F. Goddard [1964] 9 p refs Presented at 5th Rare Earth Res. Conf., Ames, Iowa
(Contract W-7405-ENG-36)
(LA-DC-7013; CONF-650804-4) CFSTI: HC $1.00/MF $0.50

Extraction of Eu by saturated lithium amalgam from aqueous lithium citrate electrolytes containing a preponderance of Gd proceeds linearly with time after an initial much more rapid extraction of a fraction of the Eu present in the electrolyte. When ammonium ion is substituted for lithium ion in the electrolyte, the initial rapid extraction of Eu is reduced by a factor of two to three, but subsequent steady-state extraction is virtually nil. The amount of Eu in the initial faster reaction depends on the method of contacting the phases. About twice as much Eu is extracted when the amalgam is dumped into the electrolyte compared to the reverse procedure of adding the electrolyte to the amalgam. Removal of Eu by electrolysis from aqueous lithium citrate electrolytes containing a preponderance of Gd starting with pure mercury (lithium amalgam cathode method) is linear with time at constant current density for short electrolysis times. The rate of removal increases as the current density is increased. No initial very rapid removal of Eu by electrolysis is observed. When ammonium ion is substituted for lithium ion in electrolytes, the removal of Eu by

electrolysis is a factor of about 1500 slower than with lithium ion present and ammonium ion absent.
Author (NSA)

N66-18860# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
POTENTIOMETRIC DETERMINATION OF FREE NITRIC ACID IN TRILAURYLAMINE SOLUTIONS CONTAINING PLUTONIUM NITRATE [DOSAGE POTENTIOMETRIQUE DE L'ACIDITE NITRIQUE LIBRE DANS LES SOLUTIONS ORGANIQUES DE TRILAURYLAMINE]
Jean-Jacques Perez and Jean-Claude Saey Mar. 1965 44 p refs In FRENCH
(CEA-R-2766)

A potentiometric method of determination of the free nitric acid in trilaurylamine solutions containing plutonium or thorium nitrates is described. The potentiometric titration is carried out in a mixture of benzene and 1,2-dichloroethane with a standard solution of trilaurylamine as the titrant. When thorium nitrate is present, the metal complex is not dissociated, and then the titration has a single endpoint. In the case of plutonium nitrate, the partial dissociation of the plutonium complex corresponds to a second point. The experimental error in duplicate analyses of 50 samples is about 1 percent for free acid concentrations in the range of 0.03 to 0.1 N and plutonium concentrations between 1 to 5 g/l.
Author (NSA)

N66-18868# Fordham Univ., New York. Graduate School of Arts and Sciences.
THERMODYNAMIC STUDIES OF SOME CHELATES IN MIXED SOLVENTS
Ahmad Dadgar (Ph.D. Thesis) 5 Mar. 1965 113 p refs
(Contract AT(30-1)-906)
(TID-21811) CFSTI: HC $4.00/MF $1.00

The dissociation constant of acetylacetone and the successive stability constants of metal acetylacetonates were studied at three different temperatures (0°, 25°, and 40° C) in methanol– and 1-propanol–water mixtures. Additional stability constant data were also obtained at 25° C in ethanol–, 2-propanol–, and dioxane–water mixtures. On the basis of a mathematical model, thermodynamic functions of the dissociation constant and the successive stability constants at constant temperature and constant dielectric constant were defined and evaluated. It was found that if log K_1, log K_2, and log β (log β=log K_1K_2) are plotted against 1/D, similar relationships are obtained. Therefore, a discussion of the results considering any one of the above quantities was sufficient to describe similar trends with the other two. When log K_2 of Ni(II) acetylacetonate was plotted as a function of 1/T, the isodielectric constant lines had nearly the same slope. This indicated that ΔG^0_D for Ni(II) acetylacetonates was virtually the same for all solvent compositions within a given solvent system (methanol– and 1-propanol–water). Hence, the main contribution to the change in ΔH^0 resulted from the variation of ΔG^0_T with solvent compositions within a given solvent system. A similar plot for Co(II) acetylacetonate showed greater variations in slope indicating that ΔG^0_D contributed significantly to the change in ΔH^0. When ΔG^0_T and ΔS^0_T of acetylacetone were plotted against the corresponding values for the chelates, linear relationships, with the points for Co(II) and Ni(II) being coincidental, were obtained. It was also observed that when log K_2 of Ni(II) acetylacetonate was plotted as a function of 1/D for different solvent systems, the methanol– and ethanol–water data gave a linear relationship whereas 1-propanol–, 2-propanol–, and dioxane–water data showed a second linear relationship with a different slope. When the pK_D of acetylacetone in mixed solvents was plotted vs. log K_2 data for various metal acetylacetonates, a series of parallel lines was obtained. From the similarity in trends, it was concluded that the influence of the solvent on chelation directly parallels the solvent influence on the ligand dissociation.
Author (NSA)

N66-18870# Oak Ridge National Lab., Tenn. Isotopes Development Center.
THE EFFECT OF AN INERT DILUENT (HEXANE) ON THE DISTRIBUTION COEFFICIENTS OF ^{99M}Tc AND ^{131}I IN METHYL ETHYL KETONE/WATER AND METHYL ETHYL KETONE/2 M NH_4OH
J. J. Pinajian Apr. 1965 10 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1058) CFSTI: HC $1.00/MF $0.50

The extraction of ^{99m}Tc and ^{131}I from methyl ethyl ketone–hexane solutions in water and 2*M* NH_4OH was measured as a function of the concentration of methyl ethyl ketone. At 20–30% methyl ethyl ketone in hexane the distribution coefficient, K_d, for ^{99m}Tc in the methyl ethyl ketone–water system showed a minimum of $\sim 6\times10^{-5}$ and for the methyl ethyl ketone–2*M* NH_4OH system, a K_d minimum of $\sim 6\times10^{-4}$. For ^{131}I, the corresponding K_d's were ~13 and ~0.5, respectively.
Author (NSA)

N66-18877# Rutgers Univ., New Brunswick, N. J.
POLAR-NONPOLAR OR AMPHIPATHIC INORGANIC COMPOUNDS Final Report
Ulrich P. Strauss 30 Apr. 1965 6 p refs
(Contract AT(30-1)-1018)
(NYO-1018-3) CFSTI: HC $1.00/MF $0.50

The results of studies of the molecular structure, interactions with cations, and hydrolytic stability of inorganic polyphosphates are summarized briefly. The structure was found to be chain-like; the branching points hydrolyze rapidly relative to the linear chains so that after a while in water, all the chains are linear. The polyphosphates were also found to have very powerful sequestering action on cations.
NSA

N66-18880# Los Alamos Scientific Lab., N. Mex.
PREPARATION AND PROPERTIES OF SOME ALKALI FLUORIDE COMPLEXES OF PENTAVALENT PROTACTINIUM
L. B. Asprey, R. A. Penneman, and F. H. Kruse [1964] 9 p refs Presented at the Intern. Conf. on Protactinium Chem., Orsay, France, 2–8 Jul. 1965
(Contract W-7405-ENG-36)
(LA-DC-6899; CONF-650701-3) CFSTI: HC $1.00/MF $0.50

Complex fluorides containing pentavalent protactinium and alkali fluoride were made, both from aqueous hydrofluoric acid solution and by fluorine oxidation of intimately ground mixtures containing PaF_4 and alkali fluoride. The major part of the work was done on the rubidium Pa(V) fluoride system. X-ray data are reported. Correlation of the properties of the complex fluorides of pentavalent protactinium with those of pentavalent uranium are made.
Author (NSA)

N66-18885# Fordham Univ., New York. Dept. of Chemistry.
THE THERMODYNAMICS AND KINETICS OF COORDINATION COMPOUNDS Progress Report

Michael Cefola and Philip S. Gentile 4 Feb. 1965 55 p refs (Contract AT(30-1)-906)
(TID-21660) CFSTI: HC $3.00/MF $0.75

Some of the techniques which will be used in nuclear magnetic resonance studies of the enol-keto equilibrium in acetylacetone, are described. The Szilard-Chalmers effect in the slow and fast neutron irradiation of praseodymium 1-phenyl-1,3-butanedione chelate was studied using extraction from $CHCl_3$ into aqueous phase, and the formation of ^{142}Pr was noted. The preparation of $Pr(TTA)_4$ is reported. Work is continuing on the reaction of pyridine and other heterocyclic amines with HIO_3+HCl, with the resulting formation of complexes of the type Py-HCl-ICl. The kinetics of the reaction of Ni^{2+} and acetylacetone to form the monoacetylacetonato complex were studied. The solvent effects in the kinetics of formation of monoacetylacetonato copper(II) were also studied. Two studies of the use of solid-solid interactions to prepare complexes are reported, in which 5 uranyl nitrate-urea complexes and 24 chelates between diacetamide and alkali and alkaline earth metal salts were obtained. The effects of dielectric constant and temperature on the stepwise formation of Ni(II) and Co(II) acetylacetonates in CH_3OH–H_2O and C_3H_7OH–H_2O mixtures were studied. NSA

N66-18904# Iowa State Univ. of Science and Technology, Ames.
ELECTRON DIFFRACTION STUDY OF NH_3, ND_3, ISOBUTYRALDEHYDE, AN N_2O_3-HF COMPLEX, AND SEVERAL CYCLOPROPANE DERIVATIVES
Jack Paul Guillory (Ph.D. Thesis) Feb. 1965 74 p refs (Contract W-7405-ENG-82)
(IS-T-8) CFSTI: HC $3.00/MF $0.75

The structural parameters of ammonia and deuteroammonia were determined for comparison with the corresponding spectroscopic values. Excellent internal agreement between the results from the least squares f(r) and least squares intensity methods was achieved. The analysis of cyclopropyl carboxaldehyde yielded normal values for bond angles and amplitudes of vibration and revealed no tendency of the aldehyde to assume a nonclassical structure of the sort hypothesized for its analog, the cyclopropyl carbinyl cation. It was found that the vapor consisted of essentially an equal mixture of *s*-cis and *s*-trans conformers. This behavior was rationalized in terms of the π-electron character of the cyclopropane ring. The 2-fold barrier hindering rotation of the aldehyde group was also estimated and found to be greater than 2.5 kcal/mole. For cyclopropyl methyl ketone, an equilibrium concentration of 80% *s*-cis isomer and 20% of an antigauche-distorted trans distribution was found. The $H_M..H_R$ nonbonded repulsions apparently destabilize the trans configuration. The equilibrium concentration of cyclopropane carboxylic acid chloride consists primarily of a broad distribution of twist isomers in the approximate range $-30° \leq \phi \leq +30°$ and is distinctly non-Gaussian in shape. The $Cl..H_R$ nonbonded in the 0° -twist conformer destabilizes this planar isomer and is probably responsible for the broad and flat shape of the twist distribution. The isomeric content of isopropyl carboxaldehyde, which may be considered to be a key fragment of 2-methylcyclohexanone, was found to be 90% gauche and 10% *s*-trans. This implies a stabilization resulting from the eclipsing of a methyl group by a carbonyl group. The barrier to rotation of the aldehyde group was estimated to be in excess of 2.5 kcal/mole. A 68° C constant boiling complex was studied by the electron diffraction technique. Analysis indicated that the vapor composition corresponded to NO_2+NO+12.6HF. The experimental NO, O–O, and HF internuclear distances in the sample were in good agreement with the values reported for independent determinations of NO_2, NO, and HF molecules. NSA

N66-18905# Oak Ridge National Lab., Tenn.
THE EXTRACTION OF INDIUM FROM HYDROCHLORIC ACID SOLUTIONS WITH n-AMYL AND n-OCTYL ALCOHOL AND ITS POSSIBLE USE FOR SEPARATING TIN AND INDIUM
K. R. Balasubramaniam and J. J. Pinajian Apr. 1965 8 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1059) CFSTI: HC $1.00/MF $0.50

The *n*-amyl alcohol and n-octyl alcohol extraction of indium from hydrochloric acid solutions was investigated as a function of the acid concentration using ^{113m}In. Equilibrium time was found to be <2 min; K_d values for *n*-amyl alcohol of 0.02, 0.048, 0.075, 0.12, and 0.15 were established for 2, 4, 6, 8, and 12*M* HCl, respectively; for *n*-ocyl alcohol, K_d values of 0.06, 0.09, and 0.11 for 2, 4, and 6*M* HCl, respectively. The results showed that 9.4, obtained with *n*-amyl alcohol and 4*M* HCl, is the maximum separation factor for this method of separating tin and indium. Author (NSA)

N66-18910# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
OXIDATION STATES OF THORIUM IN FUSED LiCl–KCl EUTECTIC
Charles Harvey Dock (Ph.D. Thesis) Feb. 1965 90 p refs
(Contract W-7405-ENG-82)
(IS-T-11) CFSTI: HC $3.00/MF $0.75

The compounds $ThCl_3$ and $ThCl_2$ were prepared by the reduction of $ThCl_4$ with thorium. X-ray powder patterns were taken of the $ThCl_3$ and $ThCl_2$ and also of $ThOCl_2$. The d spacings calculated from the powder patterns of these compounds are tabulated. Thermal data obtained from equilibrated Th–$ThCl_4$ mixtures are consistent with the existence of $ThCl_3$ and $ThCl_2$ and are used in constructing a tentative phase diagram. The data indicate that $ThCl_3$ disproportionates to $ThCl_4$ and $ThCl_2$ at 698° C, and that $ThCl_2$ decomposes peritectically at 748° C. The data indicate negligible mutual solid solubility among these compounds. Glassner's relations for the standard free energies of formation for $ThCl_4$ and $ThCl_3$ were simplified to $\Delta F^\circ_{ThCl_4} = -286,400 + 129.2T - 19.3T \log T$ cal/mole and $\Delta F^\circ_{ThCl_3} = -231,800 + 96.9T - 13.8T \log T$ cal/mole. A reasonable expression for $\Delta F^\circ_{ThCl_2}$ was found to be $\Delta F^\circ_{ThCl_2} = -172,900 + 62.9T - 9.2T \log T$ cal/mole. Electromotive force measurements of the cell Th/LiCl–KCl–$ThCl_4$/LiCl–KCl–3.3 wt % AgCl/Ag indicate that the activity coefficient of $ThCl_4$ relative to the pure solid in LiCl–KCl eutectic is about 1×10^{-3} for the concentration range 0.1 to 32.4 wt % $ThCl_4$ in the salt and the temperature range 450°–650° C. The activity coefficient of $ThCl_3$ relative to pure solid $ThCl_3$ is assumed to be unity in the LiCl–KCl eutectic. Experimental data of equilibrations of $ThCl_4$ in LiCl–KCl with thorium metal indicate that the activity coefficient of $ThCl_2$ relative to the pure solid in LiCl–KCl is about 1×10^3 at 700° C. From these values of the activity coefficients of the thorium chloride the LiCl–KCl eutectic and the free energy data for these thorium chlorides and the thorium–zinc compound, Th_2Zn_{17}, the expected extents of the reactions $ThCl_4$ (in LiCl–KCl) + 1/6 $Th_2Zn_{17}(s)$ ⇌ 4/3 $ThCl_3$ (in LiCl–KCl) + 17/5 Zn(*l*) and $ThCl_4$ (in LiCl–KCl) + 1/2 $Th_2Zn_{17}(s)$ ⇌ $2ThCl_2$ (in LiCl–KCl) + 8.5 Zn(*l*) are calculated. Experimental results of equilibrations of solutions of $ThCl_4$ in LiCl–KCl with Th_2Zn_{17} in zinc agree well with predictions that the predominant thorium chlorides in solution are $ThCl_4$ and $ThCl_3$, with the relative amounts of each depending on total thorium concentration in the salt and on temperature. It is found that higher ratios of the mole fraction of $ThCl_3$ to the mole fraction of $ThCl_4$ are favored by lower total thorium concentration in the salt and by higher temperature. Author (NSA)

N66-18931# California Univ., Berkeley. Lawrence Radiation Lab.

SOLUBILITIES, CONDUCTANCES, VISCOSITIES AND DENSITIES OF SOLUTIONS OF SELECTED INORGANIC COMPOUNDS IN DIMETHYL SULFOXIDE

Carlos A. Melendres (M.S. Thesis) Sep. 1965 68 p refs Submitted for Publication

(Contract W-7405-ENG-48)

(UCRL-16330) CFSTI: HC $3.00/MF $0.75

Studies on physical and electrochemical properties of solutions of inorganic salts in dimethyl sulfoxide (DMSO) are presented to further characterize this compound as a solvent for electrochemical systems. Data are given on the solubility of a number of salts in DMSO at 25°C, together with the conductivities, viscosities, and densities of the saturated solutions, at the same temperature. With some notable exceptions, the data presented are in reasonable agreement with some values that have appeared in the literature. The accuracy of the solubility data given is estimated to be about ±2%. A number of salts formed solid coordination compounds with the solvent. Their empirical formulas are given as determined by elemental analysis. The effect of added LiCl on the solubility and conductivity of saturated solutions of other salts was explored as a means of increasing solubility and conductivity through salt effects or complex formation in solution. A considerable increase in the solubility of some salts was observed and was attributed to complex formation. The conductivities of the binary salt solutions are higher than the specific conductivities of the corresponding single salts in DMSO. Author (NSA)

N66-18945# Oak Ridge National Lab., Tenn.

SYNTHESIS AND INFRARED ABSORPTION SPECTRUM OF DIBORANE-^{10}B

H. L. Holsopple and Lucy E. Scroggie 19 Feb. 1965 8 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1061) CFSTI: HC $1.00/MF $0.50

Essentially pure diborane-^{10}B($^{10}B_2H_6$) was prepared for the Physics Division. The compound was prepared by the incremental addition of $^{10}BF_3$-etherate to a diethyl ether solution of lithium aluminum hydride. The product was purified by fractional condensation, and its purity was established from its infrared absorption spectrum and mass spectroscopic analysis. Author (NSA)

N66-18951# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering.

RECOMBINATION OF HYDROGEN AND OXYGEN IN THE PRESENCE OF WATER VAPOR UNDER THE INFLUENCE OF RADIATION Final Report

B. B. Benjamin and H. S. Isbin Jul. 1965 36 p refs

(Contract AT(11-1)-1032)

(COO-1032-1) CFSTI: HC $2.00/MF $0.50

The gamma-ray-induced recombination of H_2 and O_2 in the presence of H_2O vapor was carried out using a cesium-137 source at water vapor pressures around atmospheric and high temperatures up to 400°F. The initial yields $G^o(H_2O)$ range from 3.0 to 6.0, and two empirical rate expressions were derived. The recombination rate was found to be first order in the H_2 concentration, increases with O_2 concentration but at a decreasing rate, and is linear with H_2O vapor concentration up to 0.3 g/L (above it, the rate becomes almost constant). The rate increases with radiation intensity but at a decreasing rate. The rate is independent of temperature up to 280°F, but increases at the higher temperatures. NSA

N66-18954# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.

THE RADIATION CHEMISTRY OF HIGH POLYMERS Technical Report No. 10, Apr. 1, 1964–Apr. 1, 1965

Malcolm Dole 1 May 1965 22 p

(Contract AT(11-1)-1088)

(COO-1088-12) CFSTI: HC $1.00/MF $0.50

In research on the radiation chemistry of high polymers, 112 samples were irradiated using gamma radiation from ^{60}Co. The development of an ultraviolet cell for absorption spectra measurements at liquid nitrogen temperature was completed. Ultraviolet absorption spectra of irradiated polyethylene were studied. The effects of N_2O on cross-linking and chain degradation in polypropylene were determined. The distribution of vinyl unsaturation between sol and gel was calculated. Vinyl group decay in irradiated polyethylene is discussed. Electron spin resonance studies were made of irradiated isotactic polypropylene. NSA

N66-18966# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 286

8 Feb. 1966 91 p refs Transl. into ENGLISH from Kao-Fen-Tzu T'ung-Hsun (Peking), v. 7, no. 5, 1965 p 304–314; 322–335; 355–372

(JPRS-34046; TT-66-30488) CFSTI: $3.00

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N66-18967 Joint Publications Research Service, Washington, D. C.

INTERFACIAL POLYCONDENSATION. III: SYNTHESIS OF POLYPHENYL ESTER

Huan-Hsing Yang, Yun-Pi Kuan, Hsi-Fung Wang, Kuang-Hsin Chou, Hsi-Hua Liu et al *In its* Transl. on Communist China's Sci. and Technol., No. 286 8 Feb. 1966 p 1–18 refs (See N66-18966 09-06) CFSTI: $3.00

The synthesis of polyphenyl ester through polycondensation reactions between tere-iso-phthaloyl chloride and bisphenol A was studied. Infrared spectra were used to measure the composition ratio between the para- and meta-isomer acids. Synthesis of polyester phenol required a much longer time than that of polyester carbonate to reach the highest molecular weight, but their relationship between recovery rate and recovery time was similar. A higher aldehyde chloride concentration in the organic phase of the chain buildup rate resulted in a higher molecular weight of the short-lived polymer

products and an easier transformation from an emulsion into a semi-solid glue state. G.G.

N66-18968 Joint Publications Research Service, Washington, D. C.
STEREOSPECIFIC POLYMERIZATION OF BUTADIENE WITH HOMOGENEOUS SYSTEMS COMPOSED OF NICKEL ACETYLACETONATE AND DIALKYL-ALUMINUM CHLORIDE
Chih-Ch'uan Shen, Lien-Sheng Chiang, Hsing-Ya Li, Ch'ung-Ch'i Chung, and Ou-Yang Chun *In its* Transl. on Communist China's Sci. and Technol., No. 286 8 Feb. 1966 p 19-46 refs (See N66-18966 09-06) CFSTI: $3.00

Nickel acetylacetonate and dialkylaluminum chloride were used as the homogeneous catalytic system to study the general regularity and dynamics of butadiene polymerization together with the chain transfer in the system. A linear relationship was found between the polymerization rate and the monomer and main catalyst (complex nickel salt) concentration; a one to two relationship was found with respect to di-isobutyl aluminum chloride, and a one to one-half ratio for concentrations of diethylaluminum chloride. The total activation energy of the polymerization was measured as 8.0 ±0.5 for butadiene in nickel acetylacetonate–diethylaluminum chloride, but the total activation energy was 8.9 ±0.5 kilocalories/mole in diethylaluminum chloride. Polymer molecular weight increased with the increased concentration of the monomer, and decreased with increased concentration of the nickel component. Calculations on the chain transfer constant gave 84 for the nickel-content component, 1.9×10^{-3} for the monomer, and 2.3×10^{-3} for the termination constant. It was concluded that the primary chain transfer for this system progresses through the nickel-constant component. G.G.

N66-19003# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
THE DRYING OF OXIDE POWDER SAMPLES FOR NEUTRON TRANSMISSION MEASUREMENTS
R. A. Elliott and N. J. Pattenden Sep. 1965 14 p refs
(AERE-M-1654) HMSO: 1s 9d

Oxides of Ba, Cd, Mo and Y were heated to temperatures of up to 600°C to determine the amount of water vapour removed. The minimum temperature required to remove all water vapour was different for different oxides. The oxides were assessed for their value as sample material for neutron transmission measurements. It was concluded that, when accurate determinations of total cross sections are required from measurements of the transmission of oxide powders, it is necessary to perform a detailed investigation of the water retention properties of the powder. Author

N66-19027# Royal Aircraft Establishment, Farnborough (England).
POLYBENZIMIDAZOLES FROM 3,3',4,4'-TETRA-AMINODIPHENYLMETHANE [POLIBENZIMIDAZOLY NA OSNOVE 3,3',4,4'-TETRAAMINODIFENILMETANA]
T. M. Frunze, V. V. Korshak, and A. A. Izyneev Nov. 1965 14 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 7, 1965 p 280-284
(RAE-LIB-TRANS-1140) CFSTI: HC $1.00/MF $0.50

Polybenzimidazoles have been prepared using 3,3',4,4'-tetra-aminodiphenylmethane as a reactant. Comparison with polybenzimidazoles prepared from tetra-aminobenzene or 3,3'-diaminobenzidine shows that the presence of the methylene group increases the solubility of the polymers and has little effect on the thermal stability. Author

N66-19123# United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
IRRADIATION OF THE CARBON DIOXIDE-METHANE SYSTEM: THE FORMATION OF FORMALDEHYDE
J. A. Hearne Sep. 1965 20 p refs
(AERE-R-5051) HMSO: 2s 6d

Carbon dioxide containing 1000 VPM of methane-^{14}C has been irradiated with 4 MeV electrons, and the yield of formaldehyde-^{14}C determined by liquid scintillation counting of the dimedone derivative. Temperatures were varied from 25° to 400°C, and some experiments were performed with unlabelled methane and the products analyzed for methanol. Initial G values for formaldehyde were in the range 1–6 molecules/100 eV. Addition of 1% CO reduced $G(CH_2O)$. Equilibrium CH_2O concentrations at high doses were about 2 VPM. No methanol was detected. Consideration of mechanisms involving CH_3 and CH_2 radicals indicate that reactions of the latter are largely responsible for CH_2O formation. Author

N66-19129# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
CONDENSATION IN A RAREFACTION WAVE Supplement No. 2
Welby G. Courtney Dec. 1965 62 p refs
(Contract Nonr-4154(00))
(RMD-5515, Suppl. 2; AD-625667) CFSTI: HC $3.00/MF $0.75

The condensation of water, methyl alcohol, and carbon tetrachloride was investigated in the rarefaction wave in a shock tube, where the rarefaction wave passes through and cools the wet gas in the high pressure side of the diaphragm and thereby induces condensation. Inert gas was Ar and N_2. A slow type of condensation and also pseudo shock condensation was observed. Interpretation of the results has proven more difficult than anticipated. This report presents the raw experimental data for the consideration of other workers. Author (TAB)

N66-19132# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
CONDENSATION OF WATER IN A CLOUD CHAMBER
Welby G. Courtney Nov. 1965 68 p refs Submitted for Publication
(Contract Nonr-4154(00))
(RMD-5515; AD-625668) CFSTI: HC $3.00/MF $0.75

The condensation of water vapor was investigated in a cloud chamber by measuring pressure as a function of time. A dense mist reproducibly formed, suggesting homogeneous nucleation occurred in the present work. Nucleation at low temperature (approximately 230° K) was significantly faster than the 0.4 particles/cc predicted by the classical theory of nucleation, and the classical theory therefore is suspect. The present results were compared to several models of condensation kinetics obtained by combining collision frequency growth kinetics with the recent 10^{20} power-revised nucleation theory amended for various types of monomer loss. Results faintly suggested that ultra-small water clusters are about 10^{-3} as stable as predicted by macroscopic cluster thermodynamics. Compression of the bulk gas due to heat conduction

from the hot walls was appreciable, both during and after expansion. Previous work which appeared to support the classical nucleation theory probably is obscured by heat conduction during expansion. Author (TAB)

N66-19152# Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center.
REDUCTION-VOLATILIZATION PROCESSES FOR RECOVERY OF MANGANESE FROM ORES
Wilbert L. Falke and Andrew A. Cochran 1966 26 p ref-(BM-RI-6738)

Procedures in which manganese compounds are reduced and the metal is volatilized and selectively condensed, a hitherto neglected area, were investigated. More than 95 percent of the manganese was recovered from high-melting-point ores whether vacuum volatilization or atmospheric pressure volatilization was used, but neither process is economically attractive under present price-cost conditions. Author

N66-19165# Centre National de Recherches de l'Espace, Brussels (Belgium).
NITROGEN OXIDES IN THE CHEMOSPHERE
Marcel Nicolet Oct. 1964 36 p refs *Its* Notes Preliminaires No. 46
CFSTI: HC $2.00/MF $0.50

The subject of nitrogen oxides was introduced [Nicolet, 1945] in aeronomic studies of nitric oxide in its consideration as an important ionic constituent of the ionospheric D region. The photochemistry of nitrogen was first studied by Bates [1952] and has been further studied by Bates [1954] and Nicolet [1954]. This problem, which is much more complicated than that of the photochemistry of oxygen, was developed by Nicolet [1955] in relation with the airglow. Calculations are difficult because the chemical aeronomy of nitrogen in an oxygen atmosphere leads to a complex problem as recently discussed by Nicolet [1960] and Barth [1961]. The presence of important concentrations of nitric oxide ions requires a special analysis of ionic reactions related to the presence or absence of the neutral molecule. Our experimental knowledge concerning rate coefficients is not yet complete, but has increased rapidly, however, in recent years and a systematic account can be found in several review papers: Three body reactions by Barth [1964], reactions involving nitrogen and oxygen by Schiff [1964] and aeronomic reactions involving hydrogen by Kaufman [1964]. Author

N66-19209# Newcastle Univ. (England). Dept. of Organic Chemistry.
RESEARCH ON ORGANIC RADIATION CHEMISTRY Final Report
G. A. Swan and L. T. Allan Jan. 1965 47 p refs (Grant AF-EOAR-61-35)
(AD-468196)

The report is divided into four parts. Part I is a gas chromatographic study of the radiolysis products of diethylamine, triethylamine, N-butylamine and 1-Methylpiperidine. Part II is a discussion of the extent of the gamma-radiation induced addition of tertiary amines to alkenes. Part III deals with the photolysis of diethylamine and triethylamine. Part IV discusses the irradiation of p-bromoaniline. Author (TAB)

N66-19227# National Bureau of Standards, Washington, D. C.
HEATS OF FORMATION OF METALLIC BORIDES BY FLUORINE BOMB CALORIMETRY Final Report, 1 Oct. 1963–30 Jun. 1965
Eugene S. Domalski and George T. Armstrong Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1965 58 p refs (Order AF 33(615)-64-1003)
(NBS-8962; AFAPL-TR-65-110; AD-625336) CFSTI: HC $3.00/MF $0.75

The purpose of this work was to provide heat of formation data on boron and intermetallic borides which are applicable to calculations involving the combustion of slurry fuels. The heats of formation of BF_3(g), CF_4(g), B_4C(c), $AlB_{2.215}$(c), α-AlB_{12}(c) and γ-AlB_{12}(c) were calculated from the heats of combustion of boron, graphite, B_4C(c), $AlB_{2.215}$(c), α-AlB_{12}(c) and γ-AlB_{12}(c) in fluorine at high pressures. The heat measurements were made in a bomb calorimeter. The samples were subjected to thorough analysis and careful characterization. Three different methods were used to prepare pelleted mixtures of the samples with Teflon powder for combustion. The completeness of combustion was determined by analysis of the unburned sample remaining in the bomb after an experiment. The heats of combustion in fluorine at 298°K and the corresponding standard deviation of the means, in kcal mole^{-1} are given as follows, along with the substances for which they were determined. The standard heats of formation at 298°K and the estimated over-all accuracies are also given. Author (TAB)

N66-19250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE PROCESS OF CATALYZED CRYSTALLIZATION BY THE METHOD OF COMBINATION LIGHT DIFFUSION SPECTRA
Ya. S. Bobovich 28 Sep. 1965 11 p refs Transl. into ENGLISH from Stekloobraznoe Sostoyanie, Tr. 3-Go Vses. Soveshch., Inst. Khim. Silikatov Akad. Nauk SSSR (Leningrad), v. 3, no. 1, 1963 p 87–90
(FTD-TT-65-689/1+2+4; AD-625786) CFSTI: HC $1.00/MF $0.50

Samples of a complex vitreous system, containing a spodumene composition with a slight addition of titanium dioxide, were investigated. It is shown that the appearance in the spectrum of a sample which has undergone full heat treatment does not yield to an interpretation of a very intense and narrow line in the low frequencies region. Actually, there is no such line in the spectra of rutile and powdery titanium dioxide. Its appearance is doubtful in the spectra of more complex titanium-containing crystals. It is also doubtful that this line belongs to vibrations of crystallized spodumene; however, it is concluded that the latter possibility cannot be completely rejected and the question of the origin of the considered line remains open at this time. R.R.D.

X66-19254# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTING AND OPTICAL PROPERTIES OF DITHIOCARBANATES OF COPPER, NICKEL, ZINC AND CADMIUM
A. P. Terent'yev, V. M. Vozkhennikov et al 3 Dec. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 2, 1965 p 405–408
(FTD-TT-65-1109/1+2+4; AD-625153) CFSTI: HC $1.00/MF $0.50

A series of chelates and polychelates were studied because of the importance placed on the dependence of electrophysical properties on atomic structures and the nature of the chemical bond. It is indicated that chelate compounds are of interest in the crystallo-chemical relationship of classes of polymeric compounds and monomeric analogs, with little studied electrophysical properties; and that they are one of the first compounds found to be of practical use in the realm of electronic organic compounds. A systematic investigation of chelates and polychelates permitted the establishment of a series of regularly conforming laws determining the semiconductor parameter of these materials. It was also established that the magnitude of the electroconductivity depends to a greater degree on the metal concentration in the specimen than on the nature of the metal. It is shown that an approximate increase in the concentration of copper by 5% leads to an increase in electroconductivity by one order. It is concluded that the introduction of organic groups enables a modification of the electroconductivity of chelates and polychelates at the expense of a change in the concentration of transition metal in the specimen. All the chelates and polychelates investigated were high resistance materials. It is further noted that high resistance parameters are characteristic of luminescent and photoconducting metals, and luminescent properties decrease with an increase in electroconductivity. R.R.D.

N66-19260# Rutgers Univ., New Brunswick, N. J. Dept. of Physics.

RELAXATION OF DILUTED NICKEL FLUOSILICATE AT LOW TEMPERATURES BY STEADY-STATE RESONANCE ABSORPTION TECHNIQUES Technical Report, Feb. 1965–Jan. 1966

Shyam H. Gurbaxani 27 Dec. 1965 13 p refs
(Contract Nonr-404(20))
(AD-625544) CFSTI: HC $1.00/MF $0.50

Relaxation rates from spin-lattice interaction were measured by the steady-state saturation of 3-cm microwaves in electron spin resonance at liquid-helium temperature for the paramagnetic material nickel fluosilicate. The absolute values of the relaxation time were in agreement with those found earlier in pulse measurements. The temperature dependence of the relaxation rate indicated that the direct process dominates. The relaxation rate decreases sharply when the magnetic concentration of the magnetic ions is reduced. The dependence of absorption signal of the microwave input power was that appropriate to homogeneously broadened lines, despite the fact that the lines of nickel fluosilicate have been thought to be inhomogeneously broadened. This behavior is interpreted in terms of the dominant role of cross relaxation processes. Author (TAB)

N66-19261# Office of Naval Intelligence, Washington, D. C. Translations Section.

REACTIONS OF CHLOROMETHYLSILANES AND SILOXANE WITH DEHYDRIC PHENOLS [O REAKTSIYAKH KHLORMETILSILANOV I SILOKSANOV S DVYKHATOMNYMI FENOLAMI]

K. A. Andrianov, V. I. Pakhomov, and N. E. Lapteva 1965 6 p Transl. into ENGLISH from Plasticheskie Massy (Moscow), v. 9, 1965 p 20–22
(ONI-TRANS-2043; AD-625613) CFSTI: HC $1.00/MF $0.50

The reaction of bis (chlormethyl) tetramethyl disiloxane and chlormethyl-dimethyl butoxysilane with resorcinol, hydroquinone or dioxydiphenyl propane (dian) was carried out in a medium of absolute butanol under nitrogen. Owing to the easy exchange of sodium between the monosodium derivative of resorcinol and the product, a mixture of oligomers was obtained—low molecular oxyphenoxymethylsiloxanes of the type $HOAr/OCH_2(CH_3)\ 2SiOSi\ (CH_3)2CH_2OAR/nOH$, where n=2–3. Similarly, the reaction of bis (chlormethyl) tetramethyldisiloxane with monodisodium derivatives of hydroquinon and resorcinol took place. In the interaction of disodium derivatives of dian with chlormethyl-butoxysilane, the resin obtained was similar to disubstituted ester of the formula $C_{28}H_{48}O_4Si_2$ with an admixture of monosubstituted ester with the formula $C_{22}H_{32}O_3Si$. Using the example of disubstituted esters of dian, the homocondensation of products of their hydrolysis with 18% HCl was studied. TAB

N66-19262# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POLAROGRAPHIC DETERMINATION OF ACROLEIN IN THE OXIDATION PRODUCTS OF PROPYLENE ON COPPER CATALYSTS

V. P. Latyshev and N. I. Popova 17 Dec. 1965 9 p refs Transl. into ENGLISH of the Publ. "Teoriya i Praktika Polyarograficheskogo Analiza" Kishinev, Izd-vo "Shtiintsa", 1962 p 406–408
(FTD-TT-65-448/1+2+4; AD-625057) CFSTI: HC $1.00/MF $0.50

A detailed investigation was made for the purpose of revealing the degree of influence of admixtures of carbonyl compounds on the height of the polarographic halfwave of acrolein in the products of oxidation of propylene on a copper catalyst, and there is given an evaluation of the precision of three quantitative methods. TAB

N66-19359* California Univ., Berkeley. Lawrence Radiation Lab.

ERP STUDIES OF OH RADICAL IN ICE AND SEVERAL CRYSTAL HYDRATES

Thomas E. Gunter *In its* Biol. and Med., Fall 1965 [1966] p 82–95 refs (See N66-19354 09-04) CFSTI: HC $4.00/MF $1.00

Studies on the EPR spectra produced by irradiation of H_2O in single crystals of ice and in several crystal hydrates were conducted. Effective spin Hamiltonian parameters were determined for a radical identified as OH. These results differ from previously published results on the samples studied. Author

N66-19375# Monsanto Research Corp., Everett, Mass. Boston Lab.

CHEMILUMINESCENT SYSTEMS Technical Report No. 6 20 Jan. 1966 27 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009Q6; AD-626937) CFSTI: HC $2.00/MF $0.50

The objective of this research is the discovery of bright, chemiluminescent reactions suitable for development into practical field systems. In this report, we discuss the heterogeneous catalysis of chemiluminescence, and we describe the emitting state in skatole chemiluminescence. An apparatus is described which was designed for the investigation of chemiluminescence enhancement by solid state catalysis. While the autoxidation of lucigenin on silica gel was non-chemiluminescent, the chemiluminescence from skatole on 5A molecular sieves appears promising. The emitting species in the skatole chemiluminescent reaction has been identified. The autoxidation of skatole in DMSO/t-BuOk has been shown to proceed to o-formidoacetophenone anion (FAP) in high yield. The

fluorescence of FAP matches the chemiluminescence emission spectrum of skatole in emission peak and contour. This identification confirms, for the more important skatole system, the identification of an emittor analogous to that previously identified in the 2,3-dimethylindole system. Analysis of the previously reported substituent effects led us to synthesize several 5-substituted skatoles in an attempt to improve the overall quantum efficiency. The materials were found to be quite similar to skatole in both efficiency and brightness, but were, however, odorless. Several factors influencing the quantum yield are discussed. TAB

N66-19392# Hull Univ. (England).
KINETICS OF HYDROGEN–OXYGEN AND HYDROCARBON–OXYGEN REACTIONS Final Report, Oct. 1962–Jun. 1965
R. R. Baldwin and R. W. Walker [1965] 15 p refs
(Grant AF-EOAR-63-31)
(AFOSR-65-1909; AD-626059) CFSTI: HC $1.00/MF $0.50

Research in the following is summarized: The development of computer programs to interpret the various aspects of the H_2-O_2 reaction; The effect of CO on the H_2-O_2 reaction; the oxidation of CH_4 when small amounts are added to slowly reacting H_2-O_2 mixtures; the effect of tetramethyl and tetraethyl silane on the second limit of the H_2-O_2 reaction; the decomposition of H_2-O_2 in the presence of H_2 and CO. TAB

N66-19432# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING HARD POLYMERS FROM N-PHENYLIMIDE OF MALEIC ACID
V. S. Ivanov, T. A. Sukhikh, A. Kh. Breger, V. O. Osipov, and V. A. Goldin 27 Oct. 1965 6 p Transl. into ENGLISH from Russian Patent no. 166832 (Appl. no. 788452/23-26, 26 Jul. 1962) 2 p
(FTD-TT-65-816/1+4; AD-625798) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of obtaining hard polymers of N-phenylimide of maleic acid which is distinguished by the feature that, for the purpose of obtaining thermally and chemically resistant material, the N-phenylimide of maleic acid is subjected to the action of ionizing radiation at a temperature not higher than, but near to, the melting point, after which the radiated product is heated up to 100°C. For the purpose of getting the polymer mainly in the crystalline of the amorphous state, the radiation is varied between 2 and 10 Mr. Author (TAB)

N66-19435# Martin Co., Baltimore, Md. Baltimore Div.
MOLECULAR VIBRATIONS BY A MATRIX FORCE METHOD
Stanley Kaufman (Res. Inst. for Advanced Studies), David B. Hall, and Joyce J. Kaufman Sep. 1964 26 p refs *Its* Tech. Rept.-64-16
(Contract AF 49(638)-1220)
(AFOSR-65-1803; AD-625874) CFSTI: HC $2.00/MF $0.50

The utility was ascertained of an existing very large IBM 7094 digital program, based on a matrix force method, to the area of molecular vibrations. The derivation of the matrix force method is outlined and compared with the matrix displacement method. Some structural elements, useful in consideration of molecular vibrations, are illustrated. The frequencies and normal vibrational modes of the molecule ethylene were computed. The excellence of the agreement between the computed and observed frequencies and between the normal modes calculated by the program and by conventional techniques demonstrates the extreme versatility of the computer program. A valence force field approximation was used. The computer program is of such generality that virtually any force field approximation may be employed (including the widely used Urey-Bradley force field and modifications of it). The capability of the program to handle extremely large problems opens new vistas in the theoretical study of vibrations of conventional molecules and of such large and complex systems as molecular and ionic crystals, molecules of biological interest and polymers. TAB

N66-19436# Stanford Univ., Calif.
FACTORS INVOLVED IN THE STABILITY OF CYCLOPROPANES Final Technical Report, 1 Oct. 1961–15 Sep. 1965
R. H. Eastman [1965] 14 p refs
(Contract AF 49(638)-1272; Grant AF-AFOSR-62-116)
(AFOSR-65-1793; AD-625080) CFSTI: HC $1.00/MF $0.50

Research accomplishments in the following areas are summarized: valence isomerization in the bicyclo/3.1.0/hexene system; steric relationship between the cyclopropane and benzene rings; steric mechanisms in the isomerization of trans-2-thujene and the reduction of dihydroumbellolone; synthesis of cyclic ketones which easily undergo photodecarbonylation in solution; mechanisms involved in a ring-chain, anhydride-diacid equilibrium. A list of publications containing detailed reports of the investigations is included. TAB

N66-19440# Auburn Univ., Ala. Depts. of Chemistry and Chemical Engineering.
A STUDY OF THE DECOMPOSITION MECHANISM OF AMMONIUM PERCHLORATE Quarterly Report, Jun. 1–Sep. 30, 1965
James E. Land [1965] 17 p
(Contract DA-01-021-AMC-12346(Z))
(QR-1; AD-625191) CFSTI: HC $1.00/MF $0.50

The research is concerned with the study of the chemical changes that occur during the decomposition of ammonium perchlorate (hereinafter abbreviated AP) produced by the application of heat. To follow the exo- and endothermic changes which are produced when AP is heated from ambient temperature to approximately 450°C., the technique of differential thermal analysis (DTA) is used. Interest is centered at present on the effect of various catalytic agents on the mechanism of AP decomposition. During the period of this report efforts continued with the making of DTA runs at various heating rates on AP samples to which had been added various materials to test the catalytic effect of these additives. TAB

N66-19477# Israel Inst. of Tech., Haifa. Dept. of Chemistry
INFRARED SPECTRA OF POLYATOMIC HIGH TEMPERATURE MOLECULES Final Scientific Report
O. Schnepp 1 Aug. 1965 14 p refs
(Contract AF 61(052)-824)
(AFML-TR-65-420; AD-625045) CFSTI: HC $1.00/MF $0.50

The far infrared absorption spectra of lithium chloride and lithium fluroide vaporization species trapped in inert solids at liquid hydrogen temperature were investigated. The spectra range 650/cm to 140/cm were covered. The out-of-plane bending vibration of the dimer was assigned for both halides investigated. Additional absorptions were observed and the

assignments are discussed. Two absorptions were observed for lithium fluoride which give isotopic substitution patterns characteristic of trimer bands. Author (TAB)

N66-19494*# National Bureau of Standards, Washington, D. C.

VIBRATIONAL FUNDAMENTALS OF CF_2N_2 FROM THE ULTRAVIOLET ABSORPTION SPECTRUM

J. D. Simmons, I. R. Bartky, and A. M. Bass 1 Feb. 1965 13 p refs Submitted for Publication

(NASA Order R-64)

(NASA-CR-60566; NBS-8625) CFSTI: HC $1.00/MF $0.50 CSCL 07C

The ultraviolet absorption spectrum of CF_2N_2 has been observed and found to include bands of two types. All of the bands of one type can be analyzed in terms of four totally symmetric vibrational frequencies plus a prominent sequence of difference bands. Some bands of the second type can be interpreted as vibronically allowed fundamentals induced by the nontotally symmetric torsional vibration. This latter assignment reveals enough information to account for the difference bands of the first type. All ground state fundamental assignments are compatible with earlier infrared and Raman results. Author

N66-19504# Sandia Corp., Albuquerque, N. Mex.

SUBSURFACE MARINE DYE MARKER EVALUATION

George Voida and Cecil Page May 1965 21 p

(Contract AT(29-1)-789)

(SC-TM-65-87)

This memorandum describes the procedures used in processing dye markers and conducting humidity and immersion tests in connection with a study conducted to evaluate subsurface marine dye markers. Also presented is a summary of conclusions reached as a result of the initial evaluation, as well as recommendations for future areas of investigation Author

N66-19581# Uppsala Univ. (Sweden).

NON-NEWTONIAN FLOW OF SOLUTIONS OF HIGH MOLECULAR WEIGHT POLYMER IN EXTREMELY VISCOUS SOLVENTS Summary Technical Report, 1 Feb.–1 Oct. 1964

Ragner Stromberg Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1965 20 p refs

(Contract AF 61(052)-392)

(AFML-TR-65-82; AD-624712) CFSTI: HC $1.00/MF $0.50

Recent theoretical work has predicted that the intrinsic viscosity of very long chain polymers in viscous solvents should increase with increasing shear gradient. Highly viscous solvents are required to develop sufficient shearing forces to overcome the inner viscosity (rigidity) of the polymer coil. This report concerns experimental work directed toward examination of the theory. Two polyphenylene oxide fractions, 1290,000 and 345,000 molecular weight, in pyralene and two polyisobutylene fractions, 600,000 and 1850,000 molecular weight, in paraffin oil, were measured in precision equipment which covered five velocity gradient ranges. The maximum shear stresses for pure water, paraffin oil and pyralene are 640, 2800 and 3900 dynes/cm^2. In these solvents no increase in intrinsic viscosity, as predicted, was observed. Although more information is required before the theory can be fully evaluated, it is suggested that the proposed treatment of gradient dependence does not take into account sufficiently the inner viscosity of the macromolecular coil and anisotropic hydrodynamic interaction. Author (TAB)

N66-19600*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

USE OF CARBON DIOXIDE TO CALIBRATE INSTRUMENTS FOR DETERMINATION OF CARBON BELOW 50 PARTS PER MILLION IN METALS

Emery J. Merkle and Judson W. Graab Washington, NASA, Mar. 1966 7 p refs Submitted for Publication

(NASA-TN-D-3350) CFSTI: HC $1.00/MF $0.50 CSCL 07B

In the determination of carbon below 50 parts per million, organic compounds have been used for calibration in the absence of suitable metallic standards. The addition of gaseous carbon dioxide (CO_2) as a calibration technique is proposed. A comparison of standardizations with an organic compound and with CO_2 additions is presented. A significant improvement in the precision of a calibration curve by using CO_2 is demonstrated. Author

N66-19644*# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.

THE DEVELOPMENT OF ULTRA-HIGH VACUUM TECHNIQUES FOR THE PURIFICATION OF NITROGEN GAS Technical Report No. 10

R. E. Miller Feb. 1966 12 p refs Submitted for Publication

(Grant NsG-193-62)

(NASA-CR-71197) CFSTI: HC $1.00/MF $0.50 CSCL 07A

Using a bakeable ultrahigh vacuum system as a basis, various methods for obtaining pure nitrogen were investigated. One method using a bulk getter of 64% zirconium–34% titanium alloy was found to produce nitrogen with impurities less than one ppm. The getter was outgassed by several bakings, and the nitrogen introduced. After several more hours at high temperature, the gas was permitted to flow into the discharge tube. This method was also found to remove hydrogen, water vapor, and the oxides of carbon. The spectrum of the gas was found to consist of strong Vegard–Kaplan bands, and emissions due to impurities were not detected or were practically nonexistent. N.E.N.

N66-19652*# National Bureau of Standards, Washington, D. C.

A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report, 1 Nov. 1964–31 Jan. 1965

George T. Armstrong, F. S. Domalski, Iva Halow, May N. Inscoe, George T. Furukawa et al 1 Feb. 1965 41 p refs

(NASA Order R-138)

(NASA-CR-71190; NBS-8641) CFSTI: HC $2.00/MF $0.50 CSCL 06A

A survey is presented of the thermodynamic properties of C, H, N, O, P, and S compounds. This includes a partial survey of heat capacity data on ubiquitous biochemical compounds, and formation heats and free energies of C, H, N, O, P, and S compounds. Also included are results of a search for ubiquitous biochemical compounds, and tables of compounds and thermodynamic data. C.T.C.

N66-19656*# Leesona Corp., Great Neck, N. Y. Leesona Moos Labs.

THE IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Quarterly Report No. 2, Sep. 4–Dec. 4, 1965

J. E. Oxley and C. W. Fleischmann [1965] 28 p refs

(Contract NAS5-9591)

(NASA-CR-70724) CFSTI: HC $2.00/MF $0.50 CSCL 07D

A further investigation has been made of the parameters which govern the growth of mossy and crystalline dendrites. It was found that the transition from one type of growth to the other occurrJd at a critical current density corresponding to the onset of diffusion control. Under ambient conditions this critical current density was 20 ±2 mA/cm^2. This finding was further confirmed by an analysis of the temperature dependence of the growth process. The effect of temperature on the deposit's adherency was also examined. Temperature does not affect adherency when the electrodeposition is diffusion controlled. For activation controlled electrodeposition, the adherency decreases with temperature. In addition, at increased temperature, dendrite growth is initiated after fewer coulombs have passed. A study on trickle-charging has been initiated. Author

N66-19696# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Semiannual Report, Apr. 1–Sep. 30, 1965
Paul Tarrant, Doug Perry, Jai Tandon, Alan Wright, and Susumu Misaki [1965] 55 p refs
(Contract DA-19-129-AMC-79(N))
(SAR-5; AD-624867) CFSTI: HC $3.00/MF $0.50

Progress is reported in the preparation of unsaturated organic compounds containing fluorine, and the development of synthetic methods to prepare various fluoroolefins which produce oil and fuel resistant elastomers that retain their elasticity at low temperatures. The preparation of perfluoroallyl chloride was improved, and this compound was treated with various alkoxide ions to produce saturated and unsaturated ethers. Lewis acid catalyzed additions of polyhaloalkanes to haloolefins were continued. In an attempt to prepare fluoronitroso compounds carrying other functional groups, nitrosyl chloride was allowed to react with unsaturated fluoroesters and ethers. The investigation of the radical addition of haloalkyl chlorides and bromides with various olefins was continued. R.R.D.

N66-19716# Commissariat a l'Energie Atomique, Grenoble (France).
STUDY OF TERPHENYL SUBSTITUTES AND TERPHENYL OM2 [ETUDE SUR LES SUBSTITUTS AUX TERPHENYLES ET SUR LE TERPHENYLE OM2]
M. Masson et al Brussels, EURATOM, Dec. 1965 157 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-062-62-4 ORGF)
(EUR-2517.f) CFSTI: HC $5.00/MF $1.00

The behavior of terphenyl OM2 in pyrolysis and radiolysis was investigated. The pyrolysis tests show that the decomposition speed of radiolyzed terphenyl is four to six times greater than that of pure terphenyl, and that this phenomenon might be related to the presence of paramagnetic active centers. The in-pile radiolysis tests carried out between 200° and 450°C show that there are two very distinct temperature zones in which the variation in the decomposition speed of terphenyl, as a function of temperature, differs considerably. In the lower temperature zones the activation energy is slight and corresponds to pure radiolysis; in the upper zone the activation energy progressively climbs up to that of pure pyrolysis. In an investigation of terphenyl substitutes, the preparation and characteristics of alkylphenanthrene sections were studied. Dosimetric methods used for the in-pile loop and the results obtained are discussed, along with the results of an error calculation for the dosimetric measurements. Transl. by D.T.

N66-19771# Battelle Memorial Inst., Columbus, Ohio.
AN INFRARED STUDY OF POLYFLUORINATED AROMATICS IN THE LOW-FREQUENCY REGION Summary Technical Report, Jun. 1964–Jun. 1965
R. J. Jakobsen Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1965 21 p refs
(Contract AF 33(615)-1706)
(AFML-TR-65-289; AD-625125) CFSTI: HC $1.00/MF $0.50

By use of the inequality rule and comparison with chlorobenzenes, the out-of-plane CF deformations of a series of unsubstituted fluorobenzenes were assigned. Tentative assignments were also made for the in-plane CF deformations. The CF deformations of a series of substituted pentafluorobenzenes were assigned and were shown to correlate with the frequencies of the unsubstituted pentafluorobenzenes. While it is not possible to use only one band for identification of ring substitution (as in the case of using CH deformations), the entire pattern of CF deformations can be used for analytical purposes. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-18497# Pacific Missile Range, Point Mugu, Calif.
PERFORMANCE OF THE AN/GMD-2 RAWIN SET IN THE DENPRO SYSTEM
R. A. Wallston 1 Dec. 1965 21 p refs
(PMR-TM-65-2; AD-625118) CFSTI: HC $1.00/MF $0.50

An analysis is performed of the velocity and altitude data derived from the AN/GMD-2 rawin set track of four flights of the density probe (DENPRO) vehicle. Data from AN/FPS-16 radars are available for two of the flights and are used as a basis for evaluating the AN/GMD-2 data. Slant ranges and vehicle velocities derived from the AN/GMD-2 compare favorably with those derived from the AN/FPS-16 data. Vehicle altitudes derived from the AN/GMD-2 are consistently lower than those derived from the AN/FPS-16. This was due to AN/GMD-2 rawin-determined evaluation angles being lower than AN/FPS-16 radar-determined evaluation angles by varying amounts, though the reason for this has not yet been determined. It has been concluded (1) that the Modified AN/GMD-2 is capable of tracking a rocket probe, (2) that AN/GMD-2 rawin-determined velocities may be expected to be within 1 per cent of AN/FPS-16 radar-determined velocities, and (3) that AN/GMD-2 rawin-determined altitudes are about 1 per cent lower than AN/FPS-16 radar-determined altitudes, up to an altitude of 400,000 feet. Author (TAB)

N66-18525# General Electric Co., Santa Barbara, Calif. Radio Guidance Operation.
READINESS PROGRAM, ANTENNA DESIGN AND DEVELOPMENT Final Design Report

28 Dec. 1965 204 p refs
(Contract AF 04(695)-476)
(WTR-65L-157; AD-625899) CFSTI: HC $6.00/MF $1.25

This report covers the design and development of a missileborne range safety antenna system for installation on the Series E/F Atlas vehicle. The antenna system is designed to operate in conjunction with the General Electric Radio Tracking System (GERTS) to provide range safety information for Atlas missiles launched from the Western Test Range. Antenna pattern requirements were derived from an integrated system analysis of missile launches associated with the 'Readiness Program'. This program requires yaw maneuvers during the sustainer portion of flight, creating 'dog-leg' trajectories for which the existing range safety antenna does not provide adequate pattern coverage. Existing 15 in., 6 in., and 4 in. traveling wave slot designs were evaluated and tested. It was determined that the 4 in. slot skewed 20 degrees and tilted 15 degrees would satisfy requirements. Utilization of the 4 in. aperture made possible the use of an existing coupler design to satisfy ground support equipment requirements. Extensive radiation measurements of both the 4 in. dog-leg antenna and the existing 15 in. GERTS antenna were made for full-scale simulations of the Atlas-vehicle in both its booster and sustainer configurations. TAB

N66-18535# Rome Air Development Center, Griffiss AFB, N. Y. Communications Div.
USE OF SUNDE TROPO CHANNEL MODEL TO PREDICT ERROR PROBABILITIES OF AMRT TESTS Final Report, Aug. 1964–Sep. 1965
Dec. 1965 202 p refs
(RADC-TR-65-427; AD-625868) CFSTI: HC $6.00/MF $1.25

Details and results of analyses and calculations are provided which were used to compute the error probabilities obtained in transmitting digital data through the Atlantic Missile Range Tropospheric Scatter Communication Channel. This effort provided a communication system model upon which these calculations could be based. The Sunde model of the tropo medium was used. Three digital PCM systems were analyzed, and compared to the FDMFM mode of operation. The AN/GSC-4 was used as a data source at 2400 bits/second for one of the 24 voice channels which were being multiplexed. The AN/MRC-98 transmitters and receivers were used on the tests. The results of computation agree with the experimentally measured data. The predictions are compared with the actual results, and the modeling technique is discussed. The satisfactory comparison of theory to experiment leads to the conclusion that the Sunde model of the tropo communication is a good one, and useful for prediction of error probabilities through a particular communication medium. Author (TAB)

N66-18560# Republic Aviation Corp., Farmingdale, N. Y.
PRELIMINARY DESIGN STUDY OF A FLAT PLATE REFLECTOR AND SUPPORT UNIT Final Report, 1 Mar.–15 Sep. 1965
Stanislaus Dubowski and Jung Git Chung 15 Oct. 1965 138 p refs
(Contract AF 19(628)-2995)
(FHR-1665-7; AFCRL-65-763; AD-625908) CFSTI: HC $4.00/MF $1.00

Aerodynamic measurements are presented based on open field aerodynamic testing of a mesh surfaced, square shaped, flat plate reflector. Forces and moments were measured on the flat plate in an isolated condition and when located at various positions within an array of 24 similar flat plates and support units. All tests were conducted on open ground and data was recorded during prevailing wind conditions in the natural environment. The extraneous loads produced by the dynamics of the system were filtered by an averaging process over five data points for the steady state values. Array locations are shown to increase the isolated forces by a factor of 4 and the isolated moments by a factor of 50 percent due to the induction effects from adjacent plates. Preliminary design airloads and moments for full scale plates of a similar construction, forming a quadrant of the Multi-Plate Antenna, are presented. Implications of the test results related to a full scale, four lobe, Multi-Plate Antenna are discussed. Author (TAB)

N66-18578# RAND Corp., Santa Monica, Calif.
CANONICALLY OPTIMUM THRESHOLD DETECTION
David Middleton Nov. 1965 87 p refs
(Contract AF 49(638)-66-C-0001; Proj. Rand)
(RM-4687-PR; AD-626162) CFSTI: HC $3.00/MF $0.50

A general canonical theory is developed for the systematic approximation of Bayes, or optimum, detection procedures in the critical limiting threshold mode of operation. Locally optimum Bayes detectors (LOBD) are defined by the condition that they produce the same value of average risk and its derivative for vanishing small input signals as do the corresponding Bayes systems. The LOBD displays comparative simplicitiy and its structure can always be found, even when the structure of the Bayes system cannot be obtained explicitly. It is found that the logarithm of the likelihood ratio is the function of the received state of the data to be approximated. In the binary situation of testing for one class of signals against another, the LOBD is found to be a linearly weighted sum of characteristics such as the likelihood ratio. A criterion of asymptotic relative efficiency is developed in order to account for the effects of correlated samples and limiting distributions that do not obey the central limit theory, i.e., are not asymptotically normal. Examples given to illustrate the derivation of LOBDs make comparisons with the corresponding Bayes systems. M.W.R.

N66-18590# Army Foreign Science and Technology Center, Washington, D. C.
MEASUREMENT OF NANOSECOND WAVE LOSSES IN WAVEGUIDES
A. B. Dogadkin Dec. 1965 11 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 11, 1964 p 27–32
(FSTC-381-T65-598; AD-626067) CFSTI: HC $1.00/MF $0.50

A pulse method is used to measure linear losses (pulse packet method) in short waveguide sections. The optimum theoretical conditions are given which provide the most exact measurements. It is shown experimentally that nanosecond radiowave losses can be measured in waveguides 5 to 10 m long. Author (TAB)

N66-18606# CBS Labs., Stamford, Conn.
TRANSDUCER AND INTERPHONE SYSTEM FOR OPERATION IN HIGH-AMBIENT NOISE Quarterly Progress Report No. 4, 1 Apr.–30 Jun. 1965

07

Allan J. Rosenheck, Emil L. Torick, and Alfred L. Di Mattia
30 Jul. 1965 60 p refs
(Contract DA-28-043-AMC-00257(E))
(Rept.-4; AD-626618) CFSTI: HC $3.00/MF $0.75

The report discusses work performed toward development of an improved Transducer and Interphone System for operation in high-ambient noise. Work progressed toward development of a tubular microphone shield. Included was an evaluation of several acoustical materials, and the fabrication of a practical shield. Earphone enclosures with LFC (Low Frequency-Coupled) volumes were constructed and tested, and results are presented herein. Performance of the present communications system was evaluated and compared with expected performance of a CBS Laboratories-designed system. Psychoacoustic tests were performed to relate articulation index with phonetically-balanced word testing. Basic electronic design of the system was completed. Each system comprises three crewmember units and an interphone amplifier. Circuits for achieving automatic gain control and squelch operation are described, including four methods for accomplishing automatic gain control. Detailed circuit descriptions as well as system designs were incorporated into the interphone amplifier, and are also described.
Author (TAB)

N66-18628# Electro Technical Analysis Corp., Tucson, Ariz.
FREQUENCY ASSIGNMENT STUDIES First Quarterly Progress Report, 1 Aug.–31 Oct. 1965
A. J. Hoehn, T. W. Mc Curnin, and L. J. Perper Ft. Monmouth, N. J., Army Electron. Command, Nov. 1965 94 p refs *Its* Rept.-1
(Contract DA-28-043-AMC-01232(E))
(ECOM-01232-1; AD-625585) CFSTI: HC $3.00/MF $0.75

The purpose of this study is to improve electromagnetic compatibility in the field army through development of improved frequency-assignment practices. The general frequency-assignment problem is defined in terms of exclusions imposed by the physical nature of equipments and geographic locations. The problem is formalized through use of mathematical set theory, and solutions discussed. The basis for design of frequency groups which automatically satisfy the set theory expressions is established. Methods for replication of assignments and the combination of the replication scheme with the frequency-group method are covered. Optimization methods, and problems arising from intermodulation and adjacent channel interference are considered. Generation of spurious signals by nonlinear devices is discussed. Realistic prediction formulas have been developed which reflect the order of nonlinearity generating the signal, and which place no limit on the number of impressed signals which may be considered. Rules are established for an assignment sequence capable of eliminating all odd-order interference generation at a radio-relay type site. An exhaustive survey of the current state of knowledge pertaining to calculation of propagation-path loss is presented. The frequency range from VLF through EHF is examined. Calculation methods and attainable accuracies are discussed. Author (TAB)

N66-18635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HORN ANTENNA WITH A COAXIAL LEAD
L. N. Luk 27 Oct. 1965 6 p Transl. into ENGLISH from Russian Patent no. 165786 (Appl. no. 869276/26-9, 7 Dec. 1963) 2 p
(FTD-TT-65-818/1+2+4; AD-625780) CFSTI: HC $1.00/MF $0.50

A horn antenna with a coaxial lead (input) for the purpose of extending the range in the direction of higher frequencies is presented. A right-angle waveguide with a gradually increasing transverse section is used to join the coaxial transmission line (feeder) to the horn. TAB

N66-18682*# IIT Research Inst., Chicago, Ill. Technology Center.
STUDY CONCERNING NONLINEAR MIXING OF RADIO FREQUENCY SIGNALS IN STEEL STRUCTURES Final Report
M. J. Frazier and S. Morissette 15 Oct. 1965 96 p refs
(Contract NAS10-2154)
(NASA-CR-70825; IITRI-E6047-7) CFSTI: HC $3.00/MF $0.75 CSCL 09F

Preliminary investigation of interferences noted during the checkout of several Saturn vehicles established nonlinear magnetization characteristics of steel as the sources of discrete frequency intermodulation. A directional antenna system was employed to locate the approximate area from which nonlinearly generated signals emitted, and small loop probes or audio probes were used to pinpoint the interference condition. This composite locating technique found a number of structural components and construction techniques that consistently produced severe nonlinearities. G.G.

N66-18891# Sandia Corp., Albuquerque, N. Mex.
CLOSE-IN TRACKING ERROR IN INTERFEROMETER TRACKING SYSTEMS
W. D. Gutscher Feb. 1965 12 p
(Contract AT(29-1)-789)
(SC-TM-65-44) CFSTI: HC $1.00/MF $0.50

It is frequently necessary to track objects with an electronic trajectory-measuring system when the object being tracked passes close by the tracking station. In systems that obtain angular information in the same manner as the Stare and Midot systems, an error is introduced into the data because of the proximity of the tracked object. An analysis is presented of the magnitude and characteristics of this error as a function of both range and direction of the tracked object.
Author (NSA)

N66-19006*# Stanford Research Inst., Menlo Park, Calif.
BANDWIDTH COMPRESSION TECHNIQUES FOR METEOROLOGICAL SATELLITE PICTURES Final Report, 1 Mar. 1964–1 May 1965
E. D. Jones, S. M. Serebreny, A. Macovski, R. G. Hadfield, D. W. Masters et al May 1965 188 p refs
(Contract NAS5-3706)
(NASA-CR-70918) CFSTI: HC $5.00/MF $1.25 CSCL 09F

A selection of TIROS and Nimbus satellite cloud pictures were processed to reduce the bandwidth required for transmission. Several analog processing methods were studied, each aimed at a 9:1 bandwidth reduction ratio. A detailed technical description of the several processes is given, together with the cloud photographs that resulted. A possible implementation of a real-time operational system is included. A discussion of noise considerations, errors, analog logic

techniques, and a comparison of the evolved bandwidth reduction system with other approaches is appended. It is concluded that the bandwidth compression schemes described here retain meteorologically significant features decidedly better than a system based on simple low-pass spatial filtering. Author

N66-19019# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
A METHOD FOR DISTINGUISHING BETWEEN GAUSSIAN AND IMPULSIVE NOISE BASED ON MOMENTS
D. A. Roy Jul. 1965 65 p refs
(Contract DRB-513003)
(RR-65-2) CFSTI: HC $3.00/MF $0.75

A method is investigated for deciding which of two types of background noise, Gaussian or Poisson impulsive, is present. The method is based on the moment ratios, μ_4/μ_2^2 and μ_6/μ_2^3, where μ_i is the i-th moment of the process. A decision rule which minimizes the overall average cost is described. To use the decision rule the conditional probability density functions of the moment ratios are required. The experimental procedure, involving linear filtering, sampling, and digital computation, in obtaining these density functions is discussed. Sample density curves of the moment ratios for different numbers of samples per moment and different filter bandwidths are presented. Assuming equal a priori probabilities of occurrence, the total probability of error for each case studied is obtained from the density curves. A method for generating normal pseudo-random numbers on a digital computer is described and the density curves using this method are compared to those obtained using the continuous Gaussian noise source. The probability of error was found to be smaller when using μ_4/μ_2^2 than when using μ_6/μ_2^3. Author

N66-19035*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF PHASE-COHERENT AND NON-PHASE-COHERENT CODED COMMUNICATIONS
J. P. Strong, III and T. V. Saliga Washington, NASA, Mar. 1966 28 p refs
(NASA-TN-D-3079) CFSTI: HC $0.35/MF $0.50 CSCL 17B

The theoretical word-error probability versus signal-to-noise ratio has been evaluated for the following five communications systems: (1) Biorthogonal phase coherent, uncoded, (2) biorthogonal phase-coherent, word coded, (3) orthogonal phase-coherent, word coded, (4) orthogonal nonphase coherent, word coded, and (5) same as (4) but with non-optimum detection. Plots and tabulations of these results are presented. The performance of the coded systems are compared to each other and to the uncoded system. It is shown that systems (2), (3), and (4) are nearly equal in performance for large numbers of bits per code word and all offer significant signal-to-noise gains over the uncoded system. If n is the number of information bits per word, then the precision of word synchronization relative to system (4) increases: (1) linearly with respect to n for the uncoded system, and (2) exponentially with respect to n for the phase-coherent coded systems. Author

N66-19044# Navy Underwater Sound Lab., New London, Conn.
THE QUASI-STATIC FIELDS OF DIPOLE ANTENNAS, PART 1
Peter R. Bannister 3 Jan. 1966 39 p refs
(USL-701; AD-626321)

The electric and magnetic field components produced by vertical and horizontal dipoles (both electric and magnetic types) are presented for the quasi-static range, absolute value (free space propagation constant $x\rho$) $<<1$, and $z=h=0$. The special cases of absolute value (earth propagation constant $x\rho$) >1 or <1, and a stratified lower half space (the earth) are examined in detail. Author (TAB)

N66-19188# Whittaker Corp., North Hollywood, Calif. Electronics Div.
ATCBI TRANSMITTER SITE IMPROVEMENTS MODEL ATCBI-3 Final Report
F. V. Hale, Jr. Dec. 1965 72 p
(Contract FA-WA-4707)
(RD-65-118)

A modification program was initiated for the air traffic control transmitter site equipment in accordance with a Federal Aviation Agency specification. This specification required certain operating characteristics be altered and other operational capabilities be added to the transmitter site equipment group. Maximum transmitter output power was increased, side-lobe suppression pulse generation and monitoring circuits were added, three-mode interlace operation was added, output rf switching between a directional and omnidirectional antenna was added, ancillary trigger outputs were added, and certain local control functions were deleted. The end result was a modification kit suitable for field installation in the basic equipment. Author

N66-19236# Auburn Univ., Ala.
A STUDY OF THE EFFECTS OF DIELECTRIC PLUG-LOADING ON SLOT ANTENNAS
James Robert Fyke (M.S. Thesis) 24 Aug. 1965 35 p refs
(Contract AF 33(608)-1207)
(AD-624682) CFSTI: HC $2.00/MF $0.50

The problem of analytically determining the effects on the input characteristics of a slot antenna of loading the slot with a dielectric plug is examined. It is found that the values of the input impedance and resonant frequency of a dielectric plug-loaded slot antenna lie between that of a slot antenna in free space and that of a slot antenna completely surrounded with dielectric material. The problem of determining the input impedance of a slot antenna at resonance in a dielectric medium in terms of the input impedance of a slot antenna at resonance in free space is solved. The results of the test on a slot antenna with a dielectric plug are presented. Author (TAB)

N66-19241# Navy Electronics Lab., San Diego, Calif.
A COMPUTER PROGRAM FOR TRACING THE RAY PATHS OF RADIO WAVES IN THE IONOSPHERE Research Report, 15 Sep.-24 Dec. 1964
J. R. Wilts 2 Sep. 1965 44 p refs
(NEL-1316; AD-625731) CFSTI: HC $2.00/MF $0.50

A computer program was developed for tracing ray paths through an arbitrary ionosphere, and is now ready for application to specific problems. The program correctly traces the opposite lateral deviations of the ordinary and extraordinary rays in good agreement with correct theoretical results. Author (TAB)

N66-19246# Illinois Univ., Urbana. Radiolocation Research Lab.

A STUDY OF HIGH-FREQUENCY DIRECTIONAL PROPAGATION OVER A 450 KILOMETER EAST-TO-WEST PATH (13 NOVEMBER 1962 TO 4 MARCH 1964), PART I AND PART II

R. F. Donnelly, D. G. Detert, and A. D. Bailey Nov. 1965 205 p refs Sponsored by ONR, Army, and RADC

(RRL-254; AD-625413) CFSTI: HC $6.00/MF $1.25

The Columbus Experiment was a relative short range HF radiolocation experiment in which measurements were made of the azimuthal and vertical incidence angles of arrival and the relative time delay of pulse transmissions from Columbus, Ohio (450 km range due east of Urbana). All observations were taken during late afternoon hours and continuing until the propagation path failed. The angle of arrival measurements were made employing a six-element interferometer system in a configuration of three two-element interferometer pairs. Vertical incidence ionosondes were operated at the midpoint and the receiving end of the path. The basic measurements of azimuthal and vertical incidence angles of arrival were taken on 126 days during the period of the Columbus Experiment. The measurements are presented point by point, approximately two hours on each graph, with both the time and angle scales being identical throughout to facilitate comparisons. It should be emphasized that no averaging of any sort is present in this data, and that each point represents one specific measurement of azimuth or vertical incidence angle. TAB

N66-19247# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A SHAPED REFLECTOR AS A PRIMARY FEED FOR HAYSTACK

A. Sotiropoulos 30 Sep. 1965 25 p refs *Its* Tech. Note 1965-15

(Contract AF 19(628)-5167)

(ESD-TDR-65-457; AD-625375) CFSTI: HC $1.00/MF $0.50

The paper describes a technique for obtaining high aperture efficiency in the Haystack 120-foot diameter Cassegrain antenna system. The approach used seeks to maximize the percentage of power intercepted by the hyperboloidal subreflector of the Cassegrain antenna system by shaping its primary feed radiation pattern. The primary feed configuration is a linearly polarized waveguide feed illuminating a specially shaped reflector. A number of theoretical antenna models were calculated and one of these antennas (a 30 wavelength diameter shaped reflector at 7750 Mcps) was fabricated and evaluated. Calculated estimates of percentage of primary feed power intercepted by the subreflector and Cassegrain aperture efficiency are presented. Author (TAB)

N66-19374# Communication Systems, Inc., Paramus, N. J.

ANALYTICAL AND EXPERIMENTAL STUDY OF CORRELATION FUNCTIONS OVER HF CIRCUITS Final Report, 1 Jul.–31 Oct. 1965

F. David, A. P. Baker, R. W. Rudmann, H. Sherman, and R. Zach 15 Nov. 1965 200 p refs

(Contract DA-28-043-AMC-00145(E))

(CSI-65-TR-773; AD-626905) CFSTI: HC $5.00/MF $1.25

The effects of the ionosphere were determined on multiple CW tones transmitted over a long haul HF circuit by recording the received data modulated by ionospheric perturbations. Reduction and analysis of the data was performed by computers. The results describe the channel behavior during various conditions of the ionosphere in terms of the correlation functions of the received signal, envelope, phase, probability distribution and fading bandwidth. Author (TAB)

N66-19380# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

ELECTRONIC EQUIPMENT INTERFERENCE CHARACTERISTICS—COMMUNICATION TYPE Quarterly Report No. 9, 1 May–31 Sep. 1965

W. R. Free and C. W. Stuckey Ft. Monmouth, N. J., Army Electron. Command, Oct. 1965 72 p refs *Its* Rept.-30 (Contract DA-36-039-AMC-02294(E))

(ECOM-02294-9; AD-626421) CFSTI: HC $3.00/MF $0.75

During the period covered by this report, investigations to extend the determination of the interference characterisitcs of U.S. Army communication equipment to include the case emission and susceptibility characteristics have continued. The major emphasis during this period has been on the development and evaluation of broadband, balanced, circularly-polarized antennas for use in measurements of the interference characteristics of communication equipment in shielded enclosures. The design, fabrication, and evaluation of (1) A conical loghelix antenna, (2) a circularly-polarized log-periodic antenna, (3) a crossed bowtie antenna, and (4) a hooded antenna are discussed. These antennas were designed to operate in the 200 Mc to 1000 Mc range. Techniques for extending the use of these antennas to lower frequencies are discussed. Author (TAB)

N66-19395# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEVICE FOR THE ANALYSIS OF THE INSTANTANEOUS SPECTRUM OF A VOICE SIGNAL IN HARMONIC DECODERS

V. I. Kulya 21 Oct. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 158600 (Appl. no. 762403/26-9, 1 Feb. 1962) 2 p

(FTD-TT-65-793/1+2+4; AD-625197) CFSTI: HC $1.00/MF $0.50

The proposed device is distinguished from the known ones by the fact that in it there is used an LC-line of delay which is open at the end and matched in the beginning, is of the low-frequency type, has branches, and is connected with a conversion system. The latter consists of linear detectors and summators arranged ahead of and behind the linear detectors in each branch of the delay line and terminated in low-frequency filters. This difference supposedly assures the obtaining of voltages proportional to the coefficients of the breaking down of the instantaneous spectrum into Fourier's cosine series. TAB

N66-19405# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF SEPARATING ONE AMPLITUDE-MODULATED SIGNAL FROM TWO MIXED AM SIGNALS WITH SUPERPOSED SPECTRA, BUT DIFFERENT CARRIERS

Yu. N. Babanov 9 Dec. 1965 9 p Transl. into ENGLISH from Soviet Patent no. 165780 (Appl. no. 699964/26-9, 2 Mar. 1961) 2 p

(FTD-TT-65-1174/1+4; AD-625072) CFSTI: HC $1.00/MF $0.50

The proposed method is characterized by the fact that for eliminating the disturbance from the original signal coming from an amplifier of intermediate frequency and representing the sum of two AM oscillations were superposed spectra, but with different carriers, there is separated (with the aid of a very-narrow-band filter) the carrying oscillation of that AM oscillation which is looked on as the disturbance. The separated oscillation is transformed in the frequency doubler, after which the obtained oscillation of double frequency is cross-multiplied with the original signal and on the product

there is superposed the original signal. By matching the phase of the oscillation of the doubled frequency and the ratio of the amplitudes of the original signal and the mentioned product, the compensation of the mixing AM oscillations is assured. The oscillations contained in the product on frequencies close to the tripled frequency of the carrying oscillations are eliminated by frequency filtrations, and the remainder containing the two AM oscillations with different carriers doubly exceeding the difference between the carrying and original oscillation either are subjected to simple frequency filtration if the spectra of these oscillations are not superposed, or in the opposite case repeatedly subjected to the described treatment, repeating it as many times as are necessary for getting the difference of the carriers at which the spectra of the oscillations can be separated by simple linear filtration. TAB

N66-19415# Aerospace Corp., San Bernardino, Calif.
ANALYSIS OF THE FREQUENCY DEPENDENCE OF MAN-MADE RADIO NOISE
E. N. Skomal Dec. 1965 21 p refs
(Contract AF 04(695)-669)
(TDR-669(S6951-24)-2; BSD-TR-66-1; AD-626157) CFSTI: HC $1.00/MF $0.50

Two theoretical noise generation processes have been proposed and analyzed as models for the experimentally observed frequency dependence of man-made radio noise in the frequency intervals 10 kcps to 20 Mcps and 100 Mcps to 500 Mcps. The computed results for the normalized variation of the noise spectral power density as a function of frequency have been shown to agree within the statistical variation of the experimental data for both frequency intervals. The proposed mechanicsm of noise generation in the higher frequency interval presumes the man-made noise arises from randomly occurring narrow i impulses. In the lower frequency interval the noise emissions are modeled assuming the pulses form a train of independent events with an average frequency of occurrence, v. The noise arising from both emission processes is presumed to be attenuated in a manner controlled by the propagation statistics applicable to radio transmission over irregular terrain from low antenna heights. TAB

N66-19442# Texas Instruments, Inc., Dallas. Science Services Div.
MULTIPLE ARRAY PROCESSOR Final Report, 1 Oct. 1964–31 Aug. 1965
James P. Edwards, III 29 Oct. 1965 159 p refs
(Contract AF 33(657)-13904; ARPA Order 104)
(AD-625607) CFSTI: HC $5.00/MF $1.00

The report describes the synthesis and evaluation of multichannel filters for the Uinta Basin Seismological Observatory. The filters were designed for use in two on-line multiple array processors (MAP). A 19-channel and a 10-channel multiple array processor were designed, fabricated and installed at the Uinta Basin Seismological Observatory. The 19-channel processor was equipped with 7 multichannel filters and 6 beam-steer outputs. These filters were designed for operation on various configurations of the subsurface 3-dimensional 16-element array. The 10-channel processor was equipped with 3 multchannel filters and 6 beam-steer outputs. All were designed for operation on the 10-element surface planar array. Author (TAB)

N66-19448*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DOPPLER EQUATION IN RANGE AND RANGE RATE MEASUREMENT
8 Oct. 1966 36 p refs
(NASA-TM-X-55373; X-507-65-385) CFSTI: HC $2.00/MF $0.50 CSCL 17I

The Doppler equation and its use for range and range rate measurempnts is discussed, including special relativistic effects, the meaning of integrated Doppler, basic limitations in the electronic measuring equipment and, the dependence between range and range rate measurements. The emphasis is on the two-way Doppler, which is of particular interest for range and range rate measurements. It is shown that the classical and relativistic two-way Doppler equations are identical. All derivations are based on time, propagation delay and phase rather than on frequency because the electronic equipment is only capable of measuring finite differences in time and phase. This approach also unifies the treatment of both classical and relativistic Doppler and the integration of Doppler frequency. It is also shown, that range and range rate measurements are not independent measurements and that rate measurements can be performed much more accurately than range measurements. The contributions of range measurements to orbit determination are therefore rather limited except for near earth phases of a mission. Author

N66-19449*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
A CRITICAL REVIEW OF THE USE OF DOPPLER FREQUENCY FOR RANGE AND RANGE RATE MEASUREMENTS
G. Kruger 16 Oct. 1965 15 p ref
(NASA-TM-X-55416; X-507-65-386) CFSTI: HC $1.00/MF $0.50 CSCL 17I

A derivation of the range rate equation (integrated Doppler equation) is presented. The derivation is based on phase and time rather than on the Doppler frequency shift. The phase method describes the physical situation and the measuring process better than the Doppler method. This greatly simplifies the derivation of equations and provides a better insight into the measuring process. As a result, the confidence in system analysis is increased and better subsystem specifications can be written which ultimately will lead to improved system performance. Author

N66-19458*# Duke Univ., Durham, N. C.
ON SIGNAL AND NOISE LEVEL ESTIMATION IN A COHERENT PCM CHANNEL
R. B. Kerr Washington, NASA, Mar. 1966 27 p refs
(Contract NAS5-3815)
(NASA-CR-412) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Joint maximum likelihood estimators are presented for the signal amplitude and noise power density in a coherent PCM channel with white Gaussian noise and a correlation receiver. The estimates are based on the correlation coefficient outputs of the receiver. From these estimators, an estimator for the quantity

$$\frac{\text{(received signal energy)/bit}}{\text{(noise power)/(unit bandwidth)}}$$

upon which the error probabilities depend, is derived. This estimator is shown to be useful as a point estimator for the signal-to-noise ratio for the higher values of this ratio, and as

an easily calculated statistic upon which to base data acceptance or rejection criteria. The acceptance or rejection levels are obtained by using confidence interval curves in conjunction with word error probability data. Author

N66-19508*# Auburn Univ., Ala. Radio Frequency Lab.
A STUDY OF ANTENNA AND RADIO FREQUENCY TRACKING SYSTEM Final Summary Report, 1 Feb. 1963–30 Nov. 1965
E. R. Graf and H. M. Summer [1965] 13 p
(Contract NAS8-5231)
(NASA-CR-71085) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Work has been performed on the study of antenna and radio frequency tracking systems. Three major areas related to a study of the phase stability of VLF propagation, the design and development of an electronically scanned tracking antenna subsystem, and a study of an inverted rf tracking system have been investigated. A summary of the work completed in the performance of these investigations is enclosed. Author

N66-19517*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCED POLARIZATION DIVERSITY AUTOTRACK RECEIVER (APDAR) 136 MC SATELLITE TRACKING EVALUATION TESTS
Ralph E. Taylor 1 Feb. 1966 34 p refs
(NASA-TM-X-55421; X-523-66-42) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The 136 Mc satellite tracking evaluation tests of the advanced polarization diversity autotrack receiver (APDAR) system are discussed. APDAR performance is compared to a conventional 136 Mc autotrack receiver of a type not utilized in STADAN (Satellite Tracking and Data Acquisition Network) by tracking the TIROS VII, IX and X satellites, as well as OSO (S-17). The performance of APDAR, utilizing an automatic polarization tracking feature, has been demonstrated to be superior to a conventional autotrack receiving system utilizing a fixed polarization. Author

N66-19552# RAND Corp., Santa Monica, Calif.
EFFECTS OF PROPAGATION ON THE HIGH-FREQUENCY ELECTROMAGNETIC RADIATION FROM LOW-ALTITUDE NUCLEAR EXPLOSIONS
W. Sollfrey Nov. 1965 36 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4741-ARPA; AD-625074) CFSTI: HC $2.00/MF $0.50

The high-frequency electromagnetic pulse radiation from nuclear explosions presents a possible detection mechanism for low-altitude or ground bursts as well as for bursts in outer space. This radiation propagates around the earth via ground wave or ionospheric reflection, and it is necessary to determine what effect this propagation will have on the received signals. The Memorandum first considers the attenuation of the pulse when it travels via ground wave. Effects of the height of the source are included. Severe selective attenuation does occur, with the higher frequency components suffering most. The ionospheric waves suffer relatively little attenuation, but are strongly dispersed, leading to limitations on the pulse length which can be resolved. The receiver bandwidth should be selected to match the ionospheric dispersion at the receiver frequency. From all these considerations, it is clear that propagation effects will very strongly modify the pulse shape and pulse amplitude relative to free space. Author (TAB)

N66-19556# Electronics Maintenance Engineering Center, Norfolk, Va.
EVAUATION OF PROPOSED MODIFICATIONS TO THE AN/UPN-15 SERIES LORAN C RECEIVERS Interim Report
Gordon T. Fedders 7 Jun. 1965 71 p
(EMEC-11-65; AD-625114) CFSTI: HC $3.00/MF $0.75

An evaluation of AN/UPN-12( ) and AN/UPN-15( ) field changes produced by EMEC was conducted. The basic AN/UPN-12 is a LORAN A receiver which is modified by installation of Field Change 1-AN/UPN-12( ) to provide LORAN C capability. Nomenclature is changed to AN/UPN-15( ) after modification. The modified equipment was installed in a naval aircraft and flown to Nassau, Bahamas. Performance data were collected enroute, on the ground at Nassau, and at the Naval Air Test Center, Patuxent River, Maryland. X and Y delay readings were recorded during both day and night periods as well as the transition periods at sunrise and sunset. The data were tabulated on graphical form for analysis. Although three of the four field changes produced no outward effect, they did contribute to overall equipment stability and reliability. The fourth modification provided a less ambiguous video display and produced much more consistent results when two ground waves were matched. Sky-wave match was more troublesome because of envelope distortion when ground and sky waves combine. Additional errors resulted when the two signals traveled via substantially different distances (the X signal 200 miles and the Y signal 1200 miles) to the receiver. TAB

N66-19574# Radio Corp. of Amer., Camden, N. J. Communications Systems Div.
DESIGN, DEVELOPMENT, AND FABRICATION OF THE HIGH-FREQUENCY SINGLE-SIDEBAND TRANSCEIVER AN/ARC-104(V) Interim Engineering Report No. 6, 1 Aug. 1965–31 Oct. 1965
31 Oct. 1965 20 p
(Contract NOw-62-1084-d)
(CR-65-591-7; AD-624697) CFSTI: HC $1.00/MF $0.50

Prototype accomplishments during the report period are provided. A program schedule showing expected deliveries of contract items is included. Assembly and checkout continued. Preliminary RFI, temperature, shock, vibration, and explosive decompression tests were completed. Antenna Coupler compatibility was established. Author (TAB)

N66-19582*# Stanford Research Inst., Menlo Park, Calif.
STUDY AND APPLICATIONS OF RETRODIRECTIVE AND SELF-ADAPTIVE ELECTROMAGNETIC WAVE CONTROLS TO A MARS PROBE First Quarterly Report
C. A. Hacking and J. A. Martin Nov. 1965 57 p refs
(Contract NAS2-2933)
(NASA-CR-70704) CFSTI: HC $3.00/MF $0.50 CSCL 09F

Special types of antenna arrays were studied and their possible use in future Mars probes was considered. Adaptive, retrodirective, and self steering antennas are defined and discussed. The results of the study of two possible cylindrical antenna configurations are presented. The studies were limited to the retrodirective class of antenna, but the study machinery could be adapted to self steering antennas having the same general antenna configuration. Antenna parameters which provide the maximum effective radiated power for transmission purposes were presented. Considered also were specific environmental conditions and their effect on system and component configurations. Environmental studies were directed toward characterizing the electromagnetic environment through

which the retrodirective antennas may operate. It was concluded that the antenna operations are more serious for the entry capsule than for the orbiting or fly-by bus. H.S.W.

N66-19587*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRACKING
[1966] 23 p
(NASA-EP-28) CFSTI: HC $0.15/MF $0.50 CSCL 17I

The electronic bonds which link space explorations to earth are described. Tracking, telemetry, control and command are the four general areas in which support is furnished after a rocket is fired. The function of each of these areas is explained. To assist in accomplishing the mission of each space probe, three major networks were established: the manned space flight network, the deep space network, and the satellite tracking and data acquisition network. A brief description of each of these networks is given. H.S.W.

N66-19651*# New Mexico State Univ., University Park. Physical Science Lab.
A GROUND BASED RIGHT CIRCULARLY POLARIZED TRIHELIX TELEMETRY ANTENNA ARRAY FOR THE 225 TO 250 Mc/SEC FREQUENCY BAND
Sep. 1963 107 p refs
(Contract NAS5-3318)
(NASA-CR-70711) CFSTI: HC $4.00/MF $0.75 CSCL 09F

The design and performance of a ground based three element helical antenna array for telemetering use in the frequency range from 225 Mc/sec to 250 Mc/sec is reported. Radiation patterns and power contour plots are given for both right circular and linear polarizations. Impedance characteristics and construction details are also given. Author

N66-19704# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TELEMETRY ANTENNA FOR LINCOLN EXPERIMENTAL SATELLITES LES-1 AND LES-2 Technical Report No. 394
Mark E. Devane and Milton L. Rosenthal 22 Jun. 1965 49 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-239; AD-624936) CFSTI: HC $2.00/MF $0.50

The telemetry antenna used on the first two Lincoln Experimental Satellites consists of four short stubs equally spaced around, and parallel to, the spin axis of the satellite. A detailed description of the antenna and its transmission-line system is presented. Theoretical and model studies leading to the design of this antenna are discussed. Calculated and measured performance data are presented and compared.
Author (TAB)

N66-19746# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
MICROWAVE OPTICAL RECEIVER TECHNIQUES Interim Engineering Report No. 2, 1 Sep.–30 Nov. 1965
J. Richard Kerr [1965] 62 p refs
(Contract AF 33(615)-3108)
(IER-2; AD-625382) CFSTI: HC $3.00/MF $0.75

The report presents the results of the second quarter of effort on a one-year applied research program on the use of various techniques for microwave optical communications through the atmosphere. The relative theoretical advantages of direct and heterodyne optical receivers are considered further, and some popular misconceptions about the nature of background noise are pointed out. Further consideration is also given to modulation and information processing techniques and to the use of multimode lasers in microwave-bandwidth systems. Specific systems are recommended which incorporate present techniques in an optimum manner. A comprehensive experimental program of direct-detection microwave-optical communications over an outdoor path has shown that the multiplier phototubes developed in this laboratory can achieve excellent results with minimum operating difficulty. Author (TAB)

N66-19758*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY DATA FRAME READOUT SYSTEM
Charles E. Cote Washington, NASA, Mar. 1966 10 p
(NASA-TN-D-3356) CFSTI: HC $1.00/MF $0.50 CSCL 09F

A visual numeric oscilloscope screen display of conveniently formatted data bits provides a unique and practical means of monitoring large quantities of digital information. Ones and zeros are represented numerically by specific Lissajous patterns (0 and 1) generated by bit-to-bit gating of sinusoids. A complete system description for a 256-bit format display is provided, and accompanying diagrams provide the detailed design. Also included are sample photographs of oscilloscope displays which illustrate the features of this system. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-18548# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A STEREOSCOPIC DISPLAY FOR ON-LINE MONITORING OF SIMULATED TERMINAL ENGAGEMENTS
William P. Harris, Richard T. Mitchell, Maxwell A. Morfield, Arthur I. Schulman, and Raymond A. Weisen Bedford, Mass., AFSC, 3 Dec. 1965 27 p refs *Its* Tech. Note 1965-58
(Contract AF 19(628)-5167)
(ESD-TDR-65-562; AD-626467) CFSTI: HC $2.00/MF $0.50

A stereoscopic, dynamic display of re-entry bodies is described. Information for the display is generated by a simulation program on an IBM 7094 and is fed to a D.E.C. PDP-1 computer. The PDP-1 drives a D.E.C. Type 340 CRT display which is viewed through a special device by a systems analyst. The body of the report gives the philosophy of the need for on-line analysis and a general description of requirements for the display. Appendices give details about the optical viewer, the mathematics of stereoscopic viewing and a set of operational instructions for the display. Author (TAB)

N66-18717# Los Alamos Scientific Lab., N. Mex.
MOVING PICTURE COMPUTER OUTPUT
J. Eddie Welch [1965] 27 p refs Presented at the Ann. Meeting of the Users of Autom. Inform. Display Equipment, New York
(Contract W-7405-ENG-36)
(LA-DC-7189; CONF-651022-1) CFSTI: HC $2.00/MF $0.50

A description is given of the way in which results from fluid dynamics calculations can be displayed using the S-C 4020 Microfilm Recorder. Included are figures showing plots of pressure contours, velocity vectors, stream function contours, streak lines, and fluid configuration. Special emphasis is given to the production of moving pictures from 4020 plots. Selected frames were chosen from several cinema sequences illustrating calculations of the flow of water from a broken dam, the passage of a blast wave through a bomb shelter tunnel, the flow of water around an obstacle in a channel, the meteor with a missile surface, and the flow of water from a sluice gate. Author (NSA)

N66-18728# Argonne National Lab., Ill.
DEL—A PERTURBATION PROGRAM WRITTEN IN FORTRAN
Louis C. Kvitek Jun. 1965 47 p refs
(Contract W-31-109-ENG-38)
(ANL-7052) CFSTI: HC $2.00/MF $0.50

DEL is a perturbation theory code which determines the fractional change in k_{eff} due to a perturbation in macroscopic cross sections and/or in the buckling. It is written in FORTRAN for the IBM-704 computer with 32K core storage and at least six tape drives, including one for the FORTRAN Subroutine Library. The analysis assumes the input of the radial distributions of sources and fluxes to result from a one-dimensional diffusion-theory calculation. Preparation of the cross-section tape is described. Author (NSA)

N66-18892# Alabama Univ., University. Dept. of Physics.
COMPUTER PROGRAM FOR NUCLEAR MAGNETIC AND QUADRUPOLE RESONANCE FREQUENCIES AND INTENSITIES, I=3/2 TO 9
Edward H. Carlson 1 Feb. 1965 14 p refs
(Contract AT(40-1)-3090)
(TID-21697) CFSTI: HC $1.00/MF $0.50

Two computer programs are described: HERDAG gives the eigenvalues and eigenvectors of a complex Hermitian matrix of any size; and ZEEMAN uses HERDAG to find the energy level schemes of any nuclear system having I=3/2 to 9 in a magnetic field that is arbitrarily oriented with respect to the principal axis of the quadrupole interaction tensor. ZEEMAN also calculates the frequencies and relative intensities of transitions, in the case in which an arbitrarily oriented oscillating r-f field is present. NSA

N66-18893# Iowa State Univ. of Science and Technology, Ames.
COMPUTER SOLUTION OF SOLVENT EXTRACTION CASCADE CALCULATIONS FOR THE RARE-EARTH NITRATE–TBP–NITRIC ACID SYSTEM
Roger Frank Sebenik (M.S. Thesis) Feb. 1965 73 p refs
(Contract W-7405-ENG-82)
(IS-T-6) CFSTI: HC $3.00/MF $0.75

A digital computer program was written for the IBM 7074 that makes it possible to carry out trial-and-error calculations for a cascade of ideal solvent extraction stages with the feed stream entering an internal stage for the system $La(NO_3)_3$–$Pr(NO_3)_3$–$Nd(NO_3)_3$–$Sm(NO_3)_3$–HNO_3–H_2O–TBP. The program was tested using a number of different assumed values of starting conditions and no difficulties were experienced as long as the compositions remained in ranges for which the equilibrium data were valid. The precision of the match of compositions obtained at the predetermined point (aqueous phase leaving the feed stage as an example) could be made to be better than the normal accuracy of chemical analysis. NSA

N66-18894# Sandia Corp., Albuquerque, N. Mex.
DYNAMIC ANALYSIS OF LUMPED MASS SYSTEMS
B. C. Ellis and V. Gabrielson Apr. 1965 43 p ref
(Contract AT(29-1)-789)
(SCL-TM-64-110) CFSTI: HC $2.00/MF $0.50

The description of complicated systems with arbitrary nonlinearities and inputs through the use of large lumped mass models has become possible with modern computer capability. This report describes the ground work required for using the SHOCK code as a tool for solving these types of problems. The report consists of the derivation of the equations of motion, how these equations are evaluated within the code, and some examples comparing the results obtained by analytical methods to those obtained by computer calculations. Author (NSA)

N66-18999 International Business Machines Corp., New York.
THE IBM 9020—A MODULAR MULTI-PROCESSING SYSTEM FOR NAS
J. R. Wood *In* FAA Automation in Air Traffic Control [1965] 23 p (See N66-18986 09-21)

Functions and characteristics are described for the five major elements which comprise the IBM 9020 data processing system of the central computer facility for the National Airspace System. These parts are the computing element, storage element, input-output control unit, peripheral adapter module, and tape control unit. The IBM 9020 system has the capability of modular growth in several functional dimensions, particularly computing, storage, and input-output. Modularity is illustrated by three systems which vary in traffic requirements; and it is pointed out that the IBM 9020 also permits modular growth in air traffic control functions. Modular configurations and configuration control are considered, along with error-checking facilities and an operational error analysis program. Multiprocessing in the IBM 9020 system, which was designed as a blank state to permit the programmer to write his own definition of multiprocessing, is discussed in terms of two model programs. M.W.R.

N66-19046# Joint Publications Research Service, Washington, D. C.
PROBLEMS IN THEORETICAL CYBERNETICS
V. M. Glushkov, ed. 3 Feb. 1966 219 p refs Transl. into ENGLISH of the book "Voprosy Teoreticheskoy Kibernetiki" Kiev, Naukova Dumka, 1965 p 1–211
(JPRS-33991; TT-66-30434) CFSTI: $6.00

Problems related to the abstract theory of automata, graph theory and its applications in the automation of design of digital automata, program automation and algorithmic languages, new algorithmic structures of mathematical machines, planning of design operations and methods for analytical description of complex geometric objects are investigated. For individual titles see N66-19047–N66-19068.

N66-19050 Joint Publications Research Service, Washington, D. C.
A METHOD FOR ABBREVIATED NOTATION OF BLOCKS OF DATA

S. D. Mikhnovskiy *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 38–44 (See N66-19046 09-08) CFSTI: $6.00

Described is a procedure for shortened notations of data blocks with incomplete filling that is based on a single dimensional row and applied to multidimensional blocks ordered with respect to increase in index. The group of sequential nonzero elements of the row bounded by the zero elements is the interval, and the indices of the first and last elements are the boundaries of the interval. The following example for breakdown of a row into intervals

$$a_1, a_2, \underline{a_3, a_4, a_5}, a_6, \underline{a_7, a_8, a_9, a_{10}, a_{11}}, a_{12}$$

shows the nonzero elements underlined. The algorithm for conversion to the shortened notation of the row is constructed by using a comparison of the number of desired elements with the boundaries of the sequential intervals. Application of this notation method to the block of base addresses ends in a block of zero dimensions consisting of a single base address. G.G.

N66-19051 Joint Publications Research Service, Washington, D. C.

THE REALIZATION OF A'-ALGORITHMS ON DIGITAL COMPUTERS

F. I. Andon *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 45–50 refs (See N66-19046 09-08) CFSTI: $6.00

Constructed is a digital computer program which realizes A'-algorithms for simplification of the minimal disjunctive normal form by analyzing the conjunctions of the investigated shortened disjunctive normal forms and isolating those which are contained in all minimal d.n.f. of the function f. This algorithm consists of a number of sequential steps. A 300 sign digital computer program was written which realizes the investigated algorithm and can be applied to the d.n.f. of up to 800 elementary conjunctions. G.G.

N66-19054 Joint Publications Research Service, Washington, D. C.

ADDRESSING OF ELEMENTS OF A BLOCK USING ADDRESS SCALES

S. D. Mikhnovskiy *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 71–80 ref (See N66-19046 09-08) CFSTI: $6.00

Address computations for an element or block of the Algol-60 language, and a system for accelerated address calculations on elements unrelated to the preceding block reference, are discussed. Calculation procedures are based on the preliminary construction of a series of relative addresses: the so-called address scale. Readdressing is limited to cases of sequential references for regularly located elements of the computer memory block, usually to elements which ordering numbers differ by a constant value. It is found that an address scale of the first order indicates the absolute address rather than the relative address and gives rapid action with additional memory expenditures. G.G.

N66-19056 Joint Publications Research Service, Washington, D. C.

OPTIMAL DISTRIBUTION AND SELECTION OF THE NUMBER OF REGISTERS IN DIGITAL COMPUTERS USING INTEGRAL LINEAR PROGRAMMING

A. S. Nikitin *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 88–96 refs (See N66-19046 09-08) CFSTI: $6.00

The problem of integral linear programming with Boolean variables was considered for: (1) two-sided limitations on the variables; and (2) integral values of these variables. A combination of the algorithm for the solution of the problem of linear programming with two-sided limitations on the variables and the algorithm for integral linear programming gave the algorithm for a solution of the problem of linear programming with Boolean variables. G.G.

N66-19057 Joint Publications Research Service, Washington, D. C.

ISOLATION OF THE CONCEPTS OF THE ALGOL LANGUAGE USING A SYNTACTICAL TABLE

Ye. E. Zhogolev *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 97–101 (See N66-19046 09-08) CFSTI: $6.00

Syntactical analysis was used to construct a translator for Algol-60 language by encoding the syntactical table in such a way that the elements of the right hand side of each metalinguistic formula are given in sequential rows. The control program sequentially unites or removes the basic symbols of the given algorithm introduced into ever larger syntactical units. The definition of each syntactical unit forms a special graph with its vertices representing other syntactical units. G.G.

N66-19058 Joint Publications Research Service, Washington, D. C.

ON PREFIX AND INFIX WRITING OF PROCEDURES IN AN ALGORITHMIC LANGUAGE

A. Ye. Kulinkovich *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 102–109 refs (See N66-19046 09-08) CFSTI: $6.00

The writing of algorithmic symbols for two place operations as prefixes and infixes is described. Infix notations fix the connector in the required order of operational fulfillment. For prefix notation the expression a+b is written in the form +ab, and with suffix notation, in the form ab+. In this form the expressions are very easily processed by computers. G.G.

N66-19059 Joint Publications Research Service, Washington, D. C.

ON A REFERENCE TYPE INFORMATION SYSTEM

V. G. Bodnarchuk, T. A. Grinchenko, and V. I. Kolin'ko *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 110–119 (See N66-19046 09-08) CFSTI: $6.00

A generalized reference computer program is described that uses Russian as the request language and reflects the binary relationships and theoretical-set operations in its information language. The program consists of three basic parts: (1) Translation of the inquiry from the Russian language to the information language; (2) search and formation of the answer to the information question; and (3) translation of the answer to the information question. Initial data of the subprogram are the codes which represent the number of names in the list of names. The subprogram extracts from the list of names those names which coincide with the numbers obtained at the output of the subprogram and sends them to a teletype. G.G.

N66-19060 Joint Publications Research Service, Washington, D. C.

SIMULATION OF A PROCEDURE FOR THE REASONING OF A SPECIALIST ON A DIGITAL COMPUTER

E. M. Kussul' *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 120–125 refs (See N66-19046 09-08) CFSTI: $6.00

Gas exchange parameters for a two-cycle diesel ship motor were calculated by computer. Among the 15 defined parameters were dissipation of gases and air to the ports, valves, and gas turbine of the engine. The entire period of blow-off and exhaust was broken into five steps and the relationships for 78 parameters were written into the transition matrix. The matrix was then placed in the memory of the computer in rows; zero elements were omitted, and the memory cell was divided into two parts. The first part contained the transition probability, and the second the beginning address of the j-th row. If the i-th parameter was known the chain was interrupted; if it was unknown, the next random number was obtained by subprogram, the first element of the row was calculated, and the remainder obtained until a negative result was found. The number of chains followed were sufficient for an approximate evaluation, and results for the various gas discharge calculations were shown on a table. G.G.

N66-19061 Joint Publications Research Service, Washington, D. C.
INPUT LANGUAGE AND DESCRIPTION OF THE PROGRAMMING PROGRAM WITH AN ADDRESS INPUT LANGUAGE
L. P. Babenko, L. I. Dovgopolaya, and G. M. Korniyenko *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 126–134 (See N66-19046 09-08) CFSTI: $6.00

Described is the programming program (PP-M) for a universal computer which has some type of address language as its input language corresponding entirely to machine commands. The translator itself consists of an autocoding block which translates the encoded information into the intermediate language, and the programming block. Under operation of the PP-M, the operative memory minimizes sequential processing of information segments and thus leads to greater economy. Examples of some addresses are included. G.G.

N66-19062 Joint Publications Research Service, Washington, D. C.
THE INPUT LANGUAGE FOR A SMALL TRANSLATOR FROM ABBREVIATED ALGOL
L. P. Babenko, S. N. Berestovaya, L. I. Dovgopolaya, G. M. Korniyenko, and V. D. Rogach *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 135–139 ref (See N66-19046 09-08) CFSTI: $6.00

A small translator from abbreviated Algol language has been developed that uses two input languages; one is abbreviated Algol, and the other an address language. The abbreviations are called when it is desired, but bit by bit operations on the codes are also possible. The translator consists of three independent blocks which in turn process the next portion of information with preliminary translation from ALGOL to the address language and then into the machine language. G.G.

N66-19063 Joint Publications Research Service, Washington, D. C.
ON WRITING ALGORITHMS FOR PROCESSING BLOCKS IN AN ALGORITHMIC LANGUAGE
A. Ye. Kulinkovich *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 140–153 refs (See N66-19046 09-08) CFSTI: $6.00

The processing of blocks is encountered in solving varied problems of a computational nature and problems related to data processing. The international algorithmic language ALGOL-60 has available figurative means for writing any algorithms which process blocks. However, this language is primarily intended for describing algorithms for the solution of problems of a computational nature, resulting in difficulties when describing a number of algorithms in ALGOL. These difficulties may be overcome by extending the figurative resources of the algorithmic languages. Certain problems related to extending the possibilities of describing algorithms for processing blocks are investigated. It is shown that introducing blocks with unfixed size; using vector cycles, inhomogeneous blocks, block numbers, assignment vector operators, and special notation of subblocks; assuming empty indices and boundary pairs in the operators; defining equations; the approach to switches and rows as blocks; and using comment brackets, broadens the possibilities of algorithmic languages in describing algorithms for processing blocks. R.N.A.

N66-19072# Harry Diamond Labs., Washington, D. C.
A PNEUMATIC TAPE-READER
Norman A. Eisenberg *In its* Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 63–92 (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

A tape-reading system that uses fleuric devices is described. The main use of these pneumatic tape-readers is the typing of duplicate letters. The system is capable of producing apparently individually typed letters at a much lower cost than letters individually typed by a human typist. The tape-reading system comprises two interlocking subsystems, the main logic subsystem and the control subsystem, and both are described in detail. The primary task of translating the tape falls to the main logic subsystem, which converts the pattern of holes in the tape into pneumatic signals, amplifies these signals, feeds the amplified signals into decoding elements, and actuates the typewriter. The control subsystem allows the operator of the tape-reader to regulate the translation process. This subsystem is responsible for advancing the tape across the reading head at the proper speed and synchronizing this motion with the main logic subsystem. Photographs and block diagrams of the system are included. M.R.W.

N66-19074 Case Inst. of Tech., Cleveland, Ohio.
A FLUID STATE DIGITAL TO ANALOG CONVERTER
Charles K. Taft and Ralph O. Turnquist *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 107–130 refs (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

Design requirements were established for a fluid state D/A (digital-to-analog) converter to be used in a fluid state digital pulse data control system. Two D/A converter designs satisfying these requirements were built and tested. One design used simple nonlinear thin plate orifices and produced a reasonably linear static output pressure characteristic. The other design used linear orifices and a bias stage and produced a linear static output pressure characteristic. Both designs were tested statically and dynamically. Static test results were in good agreement with those predicted by theory. Dynamic testing was limited to fairly low counter pulse rates, but it was possible to predict the dynamic capability of the linear orifice design from its transfer function. It is anticipated that the dynamic capabilities of the nonlinear orifice design will not be significantly different. Both designs performed satisfactorily in a complete fluid state digital pulse data control system. Author

N66-19079 Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.

A FLUID STATE ABSOLUTE PRESSURE RATIO COMPUTER

Charles A. Belsterling *In* HDL Proc. of the Fluid Amplification Symp., Vol. III Oct. 1965 p 227–243 (See N66-19069 09-03) CFSTI: HC $7.00/MF $1.75

This paper describes a pneumatic Absolute Pressure Ratio Computer with no moving parts (fluid state). It covers the concept and design of the components and circuits and includes an evaluation of the resulting demonstration system. The performance of the breadboard Fluid State Ratio Computer firmly establishes the feasibility of the concept. It demonstrates that sophisticated analog computing components can be developed to operate on fluid-state variables. It also illustrates that complex fluid state components can be interconnected into a useful system by means of straight-forward analytical techniques. Author

N66-19137*# Wyoming Univ., Laramie. Natural Resources Research Inst.

ORBITAL OPERATIONS STUDY: AN INITIAL USE-TEST OF TRIADIC DECIMAL DIGITS Technical Report No. 5

Richard J. Jiacoletti and Donald L. Veal Dec. 1965 22 p refs *Its* Inform. Circ. No. 30
(Grant NsG-658)
(NASA-CR-70364) CFSTI: HC $1.00/MF $0.50 CSCL 09D

The utilization of TRIADIC decimal digits for labeling or identifying specific values of continuous incremental data is discussed; and the results of a use test with orbital position data are evaluated. The TRIADIC digits are designed both for easy manual recognition and efficient machine recording and reading; they use the basic properties of an incrementally alternating dash, incrementally continuous notation. Their automatic characteristics are given as the sequential changes of three possible widths in a one-to-one correspondence with numerical values. Based on the test results, it is pointed out that TRIADIC digits are easily recognizable, but are not advantageously useful for labeling incremental data; and it is concluded that the utility of these digits for identifying data sheets or whole blocks of continuous data should also be use-tested. D.T.

N66-19138*# Wyoming Univ., Laramie. Natural Resources Research Inst.

ORBITAL OPERATIONS STUDY: 1965 STATUS OF TACOS, AN EXPERIMENTAL TABULAR COMPUTING SYSTEM Technical Report No. 4, Jun. 1964–Dec. 1965

C. N. Rhodine Dec. 1965 37 p refs *Its* Inform. Circ. No. 29
(Grant NsG-658)
(NASA-CR-70366) CFSTI: HC $2.00/MF $0.50 CSCL 09B

An experimental tabulating computing system (Tacos), which is to be used for research on informatic ways of portraying large amounts of orbital data, is described. The Tacos system includes equipment for (1) the formation of rigorously continuous data; (2) recording trial samples of informatic forms of data; and (3) converting data into the forms required for recording. The core of the system is an automatic tabular converter which organizes data into incremental tables with any input–output relationship desired; and the initial output recorder is an electrochemical type, modified multiple stylus. Experimentation has shown that (1) tabular conversion is very useful for orbital observing operations; and (2) incrementation can best be accomplished as part of the collecting or compiling operation. D.T.

N66-19195*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.

LEARNING PROBABILITY SPACES FOR CLASSIFICATION AND RECOGNITION OF PATTERNS WITH OR WITHOUT SUPERVISION

J. C. Hancock and E. A. Patrick Nov. 1965 101 p refs
(Grant NsG-553)
(NASA-CR-70363; TR-EE65-21; PRF-3823) CFSTI: HC $4.00/MF $0.75 CSCL 09D

Nonsupervisory problems which arise in the design of numerous types of detection systems are considered. A rather general approach is given in which (a) the solution is formulated to include nonparametric and parametric knowledge, (b) the definition of the nonsupervisory problem is extended to a class of nonsupervisory problems, and (c) it is recognized that a certain minimum amount of a priori knowledge is required for a solution to exist. The approach shows that when samples are not classified, the probability distribution of the samples is a mixture c.d.f., (cumulative distribution function). A mixture c.d.f. is constructed by utilizing the a priori knowledge available. It is then possible to determine if a sufficient amount of a priori knowledge is available for a solution to exist. By solution is meant a system that exists minimizing sample-conditional probability of error, and converging to the minimum probability of error system. Author

N66-19196*# Maryland Univ., College Park. Computer Science Center.

INPUT–OUTPUT SUBROUTINE PACKAGE UOM IOS FOR THE IBM 7090/7094

Alfred F. Beam Jan. 1966 37 p
(Grant NsG-398)
(NASA-CR-70596; TR-66-26) CFSTI: HC $2.00/MF $0.50 CSCL 09B

This report describes an input–output subroutine package for use under the IBSYS or DC-IBSYS monitor system on the IBM 7090/7094. The package is most useful in handling of nonstandard tape records under the Fortran II and IBJOB sub-monitors of IBSYS. Handling of extremely long records, input records with incorrect parity, short records, variable length records, and mixed mode records are examples of good uses for the package. Also the package may be easily used to write efficient buffering routines. Author

N66-19224# System Development Corp., Santa Monica, Calif.

RESEARCH AND TECHNOLOGY DIVISION REPORT FOR 1964

C. Baum, ed. Jan. 1965 168 p refs
(TM-530/008/00)

The objectives of the integrated research and technology division are defined, and the areas in which their activities are centered are identified. Summarized are reports on information processing research, programming systems, programming technology, language processing and retrieval, mathematics research, decision processes research, and education and training. Included is a brief description of a technique for testing the feasibility of concepts that emerge from a research effort and for providing simulation tools in empirical investigations of analytic modeling techniques of military command systems. The feasibility of using computers in assisting military decision makers is discussed, and analogies are drawn for using these systems in other applications. H.S.W.

N66-19407# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN ANALOG COMPUTER STUDY OF VAN DER POL'S EQUATION AND ITS RESPONSE TO WHITE GAUSSIAN NOISE
Eugene Ogden Conley (M.S. Thesis) Jun. 1965 102 p refs
(GAW/MECH/65-24; AD-625372) CFSTI: HC $4.00/MF $0.75

Van der Pol's equation has a nonlinearity in the first derivative term and characteristics of the equation vary with a constant in the nonlinear term. Results of a computer study of the homogeneous equation compare favorably with phase plane data and periods obtained by numerical methods. Computer analysis of responses to random excitation show that the rms decreases exponentially toward the rms of the unexcited system as the constant in the nonlinear term is increased for constant noise input. Frequencies of the excited response become more random as excitation spectral density is increased but the predominant frequency is the same as for the homogeneous equation. The work presented is the result of an analog computer study of the response of the well-known and widely studied nonlinear van der Pol equation to different power spectral intensities of random white gaussian noise inputs. The results are presented in the form of time history plots and graphs of the amplitude response of van der Pol's equation to different noise spectral intensities and different constant coefficients of the nonlinear term in the equation.
Author (TAB)

N66-19414# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
DASHER I: A PROGRAM FOR THE DYNAMIC ANALYSIS OF SHELLS OF REVOLUTION
Joseph A. Wolf, Jr. and Evelyn Mack Oct. 1965 88 p refs
(Contract AF 04(694)-427)
(ASRL-TR-121-11; AD-626412) CFSTI: HC $3.00/MF $0.75

This report presents an analysis and a computer program which permits determining the transient deformation of an undamped system which contains both inertial and elastic coupling by a time-wise step-by-step computational process. The program is developed for the purpose of Dynamic Analysis of Shells of Revolution (DASHER). The input to the program consists of the stiffness and consistent-mass matrices which are derived from a finite-element representation of the structure. Three examples are presented to illustrate the application of this program. One of these concerns the dynamic deformations of a simply-supported beam subjected to a uniform step-function loading; the second concerns the dynamic deformations of a circular cylindrical shell under a uniformly distributed external pressure having a half-sine shape time history; and the third is similar to the second except that the axisymmetric pressure loading on the cylinder has a sin (π z)/L longitudinal distribution. Guidance for the selection of an appropriate time interval for this type of step-by-step calculation is provided.
Author (TAB)

N66-19518*# Litton Industries, College Park, Md.
DIGITAL COMPUTER PROCESSING OF PFM TELEMETRY DATA
R. M. Ginnings Washington, NASA, Mar. 1966 14 p
(Contract NAS5-2664)
(NASA-CR-381) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The problems which arise in processing pulse frequency modulation (PFM) telemetry data by means of a digital computer are increased because of the large number of correlations which must be made to take advantage of the coded nature of the signal. In order to decrease the computation time, the data is severely amplitude limited; the polarity information which remains can be more easily processed by the computer. This paper estimates the frequency of the pulse-frequency-modulated data and computes the probability of error that is involved in this estimate.
Author

N66-19546# Mitre Corp., Bedford, Mass.
BAR-MULTIPLIER AND ITS GENERALIZATION
Satio Okada Dec. 1965 42 p refs
(Contract AF 19(628)-5165)
(ESD-TDR-64-172; TM-04026; AD-625764) CFSTI: HC $2.00/MF $0.50

A new and simple device, similar to an abacus, was invented by a Chinese mathematician; it is used for multiplication, division, and extracting square roots. The underlying idea is abstracted and generalized for possible application to contemporary computers in order to reduce computing time.
Author (TAB)

N66-19547# Adams (Charles W.) Associates, Inc., Cambridge, Mass.
RESEARCH ON ADVANCED DYNAMIC ATTRIBUTE EXTRACTION TECHNIQUES Final Report, Apr. 1962–May 1965
John T. Gilmore, Jr., Frank S. Greatorex, Jr., and Edward N. Chase 31 Jul. 1965 54 p refs
(Contract AF 19(628)-453)
(AFCRL-65-736; AD-625181) CFSTI: HC $3.00/MF $0.50

Two main areas of effort are described. The first is the development of a color display system which allows for the definition and modification of data stored in a list structure. The second area is the development of a man-graphic communication system which utilizes a buffered display scope, light pen and push-bottom panel to provide the console user with the basic ability to draw charts, diagrams, curves, etc., on the face of the display scope. The drawings may contain graphic and alphanumeric information, which is reduced to a condensed digital format called an entity table. The table can be operated on by special-purpose software operators either during the drawing action or after the drawing is completed.
Author (TAB)

N66-19568# Naval Postgraduate School, Monterey, Calif.
THE DESIGN AND CONSTRUCTION OF A COMPUTER SIMULATION
Colin P. Hammon (M.S. Thesis) 1964 158 p refs
(AD-615652) CFSTI: HC $5.00/MF $1.00

A procedural approach to the design and implementation of a computer simulation model is presented, with a simulation model description and computer code. The discussion and example are intended as reference material for the computer science and computer war gaming courses offered at the United States Naval Postgraduate School. The sample computer simulation was designed for the statistical analysis of the comparative effectiveness of different ASW helicopter search tactics in a variety of tactical and physical environments. This simulation has available a wide range of input parameters and is applicable to all ASW helicopters and any search plan employing ten helicopters or less. The accompanying FORTRAN computer code was written for the CDC 1604 computer, and is adaptable to the IBM 7090-94 by the inclusion of the appropriate control cards and random number generator.
Author (TAB)

N66-19588*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DATA LOADING ROUTINE FOR THE IBM 7094 AND 7094-704X SYSTEMS
Lawrence F. Hatakeyama Washington, NASA, Mar. 1966 48 p refs
(NASA-TN-D-2850) CFSTI: HC $2.00/MF $0.50 CSCL 09B

A data loader for Fortran IV coded programs to be executed on an IBM 7094 digital computer is described. It is given control through a calling statement and does not require preconceived formats for the conversion and loading of data. The calling sequence is presented and the execution of the routine is explained. The decimal data items recognized by the routine include integers, single-precision floating point numbers, single-precision fixed point numbers, and double-precision floating point numbers. No restrictions are placed on punching of any of these types of data within any given decimal data field. A test program is addended. H.S.W.

N66-19618*# Case Inst. of Tech., Cleveland, Ohio. Engineering Design Center.
ANALOG-DIGITAL, DIGITAL-ANALOG CONVERTER FOR A DIGITAL CONTROL SYSTEM SIMULATOR
Bruce Lehtinen (Ph.D. Thesis) [1965] 166 p refs
(Grants NsG-36-60; NSF GE -2546)
(NASA-CR-71057; EDC-1-65-34) CFSTI: HC $5.00/MF $1.00 CSCL 09B

The design and construction of a unit consisting of one analog-to-digital converter, one digital-to-analog converter, and digital control logic is described. The unit is used with a real time analog computer and a digital logic synthesizer to make possible the simulation of absolute and incremental digital control systems having single digital feedback loops. The analog-to-digital and digital-to-analog converters are analyzed, and predicted performance is compared to actual observed performance. A sample simulation is presented to demonstrate how the unit can be used, and complete operating and calibration instructions are provided in the form of an operation manual. Author

N66-19619*# Case Inst. of Tech., Cleveland, Ohio. Engineering Design Center.
A TRANSITION MAP METHOD OF COUNTER SYNTHESIS
William E. Gromen 1965 132 p refs
(Grant NsG-36-60)
(NASA-CR-61056; EDC-1-65-35) CFSTI: HC $4.00/MF $1.00 CSCL 09B

Conventional procedures for the synthesis of counters apply only to synchronous designs. A synthesis method is presented which provides a complete description of the logical operation of both synchronous and asynchronous counters. The logical operation of a flip-flop is characterized in terms of state transitions. A convention is defined for representing the logical action of a flip-flop on a map. A standard form of problem statement is given, and rules for translating the synthesis problem into transition map form are presented. Input equation derivation rules and input equation requirements are defined. The asynchronous synthesis procedure is formally defined, and a detailed example of its application is given. Author

N66-19678# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PNEUMATIC CONVERTER
V. I. Levin and A. M. Krupnik 10 Nov. 1965 5 p Transl. into ENGLISH from Russian Patent no. 166183 (Appl. no. 803550/26-24, 16 Nov. 1962) 2 p
(FTD-TT-65-990/1+2+4; AD-624906) CFSTI: HC $1.00/MF $0.50

The object of the invention is a pneumatic converter of any unique *r*-th code (where 4 is the count of the convertible ordinal numbers) into any kind of a binary code for use in systems of neutralized monitoring and control. For the purpose of obtaining a nondivergent and rapid device, it is designed on pneumatic logic elements 'or' for two inputs, for example, on elements with a freelying membrane joined for each binary bit into the system 'or' with so many inputs as '1' contains the given binary bit of the table of the binary code. For the purpose of using the elements 'or' simultaneously in two or several binary bits in cases where in these bits onto the inputs of the element 'or' there should be passed identical combinations of convertible input numbers and the outputs of the elements 'or' connected up simultaneously to the inputs of some binary bits. Author (TAB)

N66-19719# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
AUTOMATIC SAMPLE CHANGING SYSTEMS UTILIZING THE AECL-2041 DIGITAL READ-OUT SYSTEM
W. D. Howell and W. R. J. Shorey Nov. 1965 54 p
(AECL-2517) CFSTI: HC $3.00/MF $0.50 CSCL 09B

A number of automatic sample changing and counting systems utilize the general purpose read-out system for data logging. This report describes the various systems with particular emphasis on the control and sample changing mechanisms and the details of modifications to the read-out system for satisfying user requirements. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-18488# Mallory (P. R.) and Co., Inc., Indianapolis, Ind.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, Jun. 30, 1964-Sep. 29, 1965
A. W. H. Smith [1965] 11 p
(Contract DA-36-039-AMC-03623(E))
(QR-9; AD-625584) CFSTI: HC $1.00/MF $0.50

The balance of the production run capacitors were manufactured and Group A tested. One lot consisting of 1692 capacitors, reached the 2000 hour life test point in Group C. One failure was recorded. All equipment is now available. Group B and most of the Group D tests will be completed next quarter. The balance of the Group C test units are expected to reach the 1000 hour test point by the end of the tenth quarter. Author (TAB)

N66-18490# ITT Electron Tube Div., Roanoke, Va.
PRODUCTION ENGINEERING MEASURE FOR TYPE FW-202 BARRIER GRID STORAGE TUBE, OCTOBER 1-DECEMBER 31, 1964

J. D. Hagan [1964] 21 p
(Contract DA-36-039-SC-85967)
(Rept.-14; AD-625190) CFSTI: HC $1.00/MF $0.50

During the report period, thirty-four tubes were placed in stock after complete specification testing. Major causes of reject tubes are still defective targets and low beam currents. The new style gun construction has greatly reduced the low beam current problem. Author (TAB)

N66-18492# Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE (PEM) FOR SILICON MIXER DIODE Quarterly Progress Report, 1 Jul.–30 Sep. 1965
G. Bowne, R. Bayliss, and C. Brunquell [1965] 60 p
(Contract DA-36-039-AMC-06159(E))
(QPR-2; AD-625755) CFSTI: HC $3.00/MF $0.75

The Second Engineering Test Sample Run has been completed using the new package design based on a beryllium oxide body with brazed metal end pieces. Test data show the design to be satisfactory from an electrical characteristic viewpoint. Analysis of Group B test data on units from the First Engineering Test Sample Run show environmental test results reasonably close to the objective AQL levels except for Moisture Resistance. Step stress analysis of storage life test data on units from the first run show a failure rate of 0.1% per 1000 hours compared to the objective 0.001%. Author (TAB)

N66-18541# Bliley Electric Co., Erie, Pa.
PRODUCTION ENGINEERING MEASURE CR-(XM-45)/U CRYSTAL UNITS Final Report, May 1962–Aug. 1965
J. M. Wolfskill, A. R. Krespan, and R. C. Mouck Sep. 1965 134 p
(Contract DA-36-039-SC-86719(E))
(AD-625831) CFSTI: HC $4.00/MF $1.00

The report covers Step I of the PEM study. It outlines the original objectives; discusses the design problems; traces the progress of the development; presents the specification finally derived; gives details of the designs established; includes a process manual to describe manufacturing operations and a quality control system for controlling and monitoring production; finally, it lists production yields and summarizes performance-evaluation data from 300 pilot-run samples. The project was concluded satisfactorily; a cumulative yield of 58.5% was obtained during the pilot run. There were no significant differences between natural quartz units and cultured quartz units, either in yields or performances. Statistical evaluation indicated that at least 99% of the pilot-run units met all requirements; more than 90% had performance levels significantly better than required to satisfy the specification. TAB

N66-18547# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MINIATURE AND SUBMINIATURE TUBE WARM-UP STUDIES
S. A. Buckingham, M. H. Stephan, and F. L. W. Moehle Feb. 1956 47 p
(Contract NOrd-7386)
(TG-245-6; AD-626417) CFSTI: HC $2.00/MF $0.50

Increasing attention is being paid to the problem of rapid warm-up of the electronic hardware in guided missiles. At present, electron tube specifications afford no control on the tube warm-up characteristics. Described in this paper, are the results of a series of experiments upon commonly used miniature and subminiature tubes, and some of the variables influencing warm-up time are separated and analyzed. A method of improving warmup by short duration over-voltage pulsing of the heaters has been explored. Several approaches are suggested by which the missile design engineer may cope with a requirement for rapid warm-up. Author (TAB)

N66-18593# Martin Co., Baltimore, Md.
INVESTIGATIONS USING SEGMENTED COLLECTOR THERMIONIC CONVERTERS Yearly Technical Summary Report, 1 Jan.–15 Dec. 1965
J. D. Long and John Psarouthakis 15 Jan. 1966 78 p refs
(Contract Nonr-3639(00))
(MND-3247; AD-626593) CFSTI: HC $3.00/MF $0.75

A total of five different collectors were investigated as collector materials in thermionic test converters each incorporating segmented collectors for simultaneous testing within the same environment. The metals tested were niobium, oxygenated niobium, plasma-sprayed ruthenium, molybdenum and rhenium. One ruthenium collector surface was used in each diode to permit intercomparison of the two converters. Both converters used a single plasma-sprayed Ru emitter which was common to the three collectors. Ruthenium, niobium and oxygenated niobium were tested in the first converter. The collector work functions varied within about 0.1 ev from one substrate material to another, with minimum values as low as 1.1 ev. It is probable that the oxygen present in the oxygenated niobium either migrated to the other collector surfaces or evaporated and was subsequently absorbed by the other surfaces. The adsorbed oxygen and cesium vapors probably formed CsO_2 and Cs-vapor layers on the substrate, thus bring about the low work functions. Molybdenum, rhenium and ruthenium were tested in the second converter. This converter did not incorporate any purposely oxygenated surfaces. The work functions obtained from these metals with adsorbed cesium were higher than those under the pressure of oxygen as expected. Author (TAB)

N66-18594# CTS Knights, Inc., Sandwich, Ill.
HIGH PRECISION 5 MC QUARTZ RESONATORS FOR TEMPERATURE CONTROL BETWEEN 20° AND 30°C, 10 JUNE–10 SEPTEMBER 1965
[1965] 42 p ref
(Contract NObsr-89290)
(Rept.-9; AD-625669) CFSTI: HC $2.00/MF $0.50

The aging rates of 5 mc, fifth overtone 'room temperature' units for the last two of approximately four and one half months, confirm the conclusions that a very significant gain has been achieved by designing units for operation near the inflection temperature. The effect upon frequency and upon the slope of the aging curve of interruptions of oscillation and temperature control are shown both for units with very low rates of aging and for units with relatively high aging rates. Author (TAB)

N66-18606# David Sarnoff Research Center, Princeton, N. J. Microwave Applied Research Lab.
DEVELOPMENT OF A LARGE DYNAMIC RANGE TUNNEL DIODE AMPLIFIER FOR PHASED ARRAY RECEIVERS Final Report, 1 Jan.–30 Sep. 1965
Adolph Presser [1965] 84 p refs Prepared for Lincoln Lab., MIT
(Contract AF 19(628)-500)
(ESD-TDR-65-59; AD-626224) CFSTI: HC $3.00/MF $0.75

An investigation was made to develop large dynamic range S-band tunnel diode amplifiers for phased array receivers. The report covers a reproducibility study of these amplifiers, and the investigation of amplifier characteristics pertinent to phased array applications. Three two-stage tunnel diode amplifiers were delivered to Lincoln Laboratory. These amplifiers operate at a center frequency of 2.85 Gc/s±2%, have a 1.5dB bandwidth ranging from 400–450 Mc/s at a gain of 18.0 to 18.5 dB, and have a noise figure between 5.6 and 5.9 dB. The amplifiers are unconditionally stable, and their output power at the 1 dB compression point ranges from −10.5 to −12 dBm. The phases of any two amplifiers track within ±3° over a band of 110–190 Mc/s, and the amplitudes track within ±1/2 dB over a band of 290–410 Mc/s. Author (TAB)

N66-18624# Radio Corp. of America, Mountaintop, Pa.
PRODUCTION ENGINEERING MEASURE ON 2N3375 SILICON OVERLAY TRANSISTOR Quarterly Progress Report No. 3, 1 Jul.–30 Sep. 1965
F. Tumbelty and J. C. La Berge [1965] 91 p
(Contract DA-36-039-AMC-03643(E))
(Rept.-3; AD-626437) CFSTI: HC $3.00/MF $0.75

The following observations were made from the results of work performed in device processing areas: (1) Tests made on devices that incorporated n-type diffusion demonstrated that $POCl_3$ results in better control over impurity distribution. (2) The absence of metallization interface failures has confirmed that gold is the most suitable material for the mounting surface. (3) Evaluation of life test and yield improvement results have shown that it is advisable to use a double evaporation system and increased thickness of the standard metal for contact metallization. (4) Ultrasonic lead bonding has been improved considerably. (5) Tightened endpoint criteria were necessary to establish an initial failure rate. A number of investigations were either continued or initiated during this quarter: the investigation of oxide growth and doping was continued; various photosensitive materials were investigated; and hot spot detection with temperature sensitive phosphorus were investigated. Wafer handling fixtures were developed and are currently in use. Author (TAB)

N66-18626# Tung-Sol Electric, Inc., Linvingston, N. J. Chatham Electronics Div.
HIGH SPEED POWER AMPLIFIER USING AN ELECTRON SWITCHED P-N JUNCTION Interim Development Report, Aug. 27–Nov. 27, 1965
Nelson E. Ake [1965] 21 p
(Contract NObsr-93308)
(QR-2; AD-625420) CFSTI: HC $1.00/MF $0.50

A bare contoured junction does not hold up under a combination of vacuum and temperatures above 90°C in the test chamber. Planar junction diodes were made which withstood a combination of vacuum and a temperature of 150°C for a period in excess of 1000 hours. Limited results were obtained in making large area diodes either planar or open junction when the penetration of the rectifying junction is greater than 6 microns. The feasibility of selectively etching a dice down to within 2–3 microns of the junction was demonstrated.
Author (TAB)

N66-18632# Arkansas Univ., Fayetteville.
A MICROWAVE RADIO RELAY SYSTEM
Howard Edward King (M.S. Thesis) 1966 37 p refs
(AD-624669) CFSTI: HC $2.00/MF $0.50

A microwave radio relay system is a communications system whereby information is transmitted from one location to another via radio frequency energy. The installation and testing of such a system on the University of Arkansas campus between the Science Engineering Building and the Engineering Building is discussed. The system has been installed and tested for proper operation. TAB

N66-18636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-VOLTAGE NANOSECOND PULSE OSCILLATOR
A. S. Nasibov, V. L. Lomakin, and V. G. Bagramov 21 Oct. 1965 7 p Transl. into ENGLISH from Russian Patent no. 168754 (Appl. no. 859577/26-9, 3 Oct. 1963) 2 p
(FTD-TT-65-630/1+2+4; AD-625795) CFSTI: HC $1.00/MF $0.50

A generator of nanosecond high-voltage pulses which contains a shaping line, a discharge pulse thyratron, a transmitting line designed on coaxial cables, and a correction circuit is described. A two-step forming line shunted by capacitance is connected in parallel to a discharge thyratron to increase the amplitude of the pulse and as a preliminary correction of its plane part. TAB

N66-18637# Naval Civil Engineering Lab., Port Hueneme, Calif.
HIGH SPEED POWER SWITCHING SYSTEM Interim Report, Jun.–Sep. 1965
Richard Donaldson Nov. 1965 11 p
(N-786; AD-625660) CFSTI: HC $1.00/MF $0.50

The operation of critical electronic equipments at Naval installations is impaired by very brief power discontinuities. A feasibility study was made of developing a suitable switching system. Details on the system and circuits of a preliminary breadboarded model 6 millisecond, 3 KVA power source switching system are given. TAB

N66-18638# Raytheon Co., Burlington, Mass. Spencer Lab.
HIGH EFFICIENCY COOLING AND FACILITY MAINTENANCE Final Report
L. J. Nichols Dec. 1965 66 p refs
(Contract AF 30(602)-3441; ARPA Order 388; Proj. Defender)
(AD-626477) CFSTI: HC $3.00/MF $0.75

An evaluation of pulsed peak power Amplitron vanes was carried out in the following four programs. The first program consisted of the design and evaluation of an inverted magnetron diode. During this program a test vehicle suitable for testing vanes at dissipation levels up to 400 kW/sq cm was designed and evaluated. The second program consisted of a study to determine the most suitable materials for pulse tube vanes, and the incorporation of these materials in test vanes. The six most suitable materials in test vanes were worked out. The third program that was carried out consisted of designing and constructing a diode life test facility which allowed a number of diode tests to be conducted simultaneously. During the fourth program the effects of pulsed electron bombardment of platinum was studied. The effect was studied at five different dissipation density levels. This study confirms that surface stress cracking will occur at dissipation density levels over 100 kW/sq cm at a 10 microsec pulse width. It shows that while there is a large amount of surface roughening at dissipation density levels of 250 kW/sq cm, thousands of hours of operation are possible at dissipation density levels up to 250 kW/sq cm. Author (TAB)

N66-18640# Harry Diamond Labs., Washington, D. C.
A DUAL-MODE PHASE-LOCKED LOOP
Charles A. Baird, Jr. 30 Sep. 1965 37 p refs
(HDL-TM-65-48; AD-625944) CFSTI: HC $2.00/MF $0.50

A dual-mode phase-locked loop is described, and its feasibility in a noisy environment is studied. This study is made through analog computer simulating with signal-to-noise ratios of 0.5, 1, and 2. In particular, the acquisition behavior for large initial frequency deviations is examined. It is apparent from the results that the loop is very effective in improving the acquisition range and times, even under noisy conditions. Author (TAB)

N66-18641# Field Emission Corp., McMinnville, Oreg.
DESIGN STUDY OF A PHOTOELECTRICAL TRIGGER SYSTEM Technical Report, 15 Feb.–28 May 1965
Frank M. Collins Kirtland AFB, N. Mex., AF Weapons Lab., Dec. 1965 50 p refs
(Contract AF 29(601)-6757)
(AFWL-TR-65-157; AD-625778) CFSTI: HC $2.00/MF $0.50

A moderate-energy pulsed power system discharges 15 Marx-surge pulsers in parallel into an exploding-wire load. The present trigger system, which utilizes a common ultraviolet (uv) light source to irradiate a trigger gap in each pulser, requires operation with the pulser charging voltage set within about 2 percent of self-fire voltage to achieve simultaneous discharge of all pulsers within about ≈2 nanoseconds. This degree of synchronism is essential to achieve minimum voltage rise-time and hence maximum wire temperature. The study describes an improved 'photoelectrical' trigger system successfully developed experimentally, in which a fast-rise voltage trigger pulse is applied to a third electrode in the pulser trigger gap subsequent to uv illumination of the gap. Statistical data have been taken with a single pulser which predict successful triggering of the 15 system pulsers with a discharge simultaneity of about ≈1 nanosecond, for a pulser charging voltage of about 10 percent below self-fire, while still maintaining original system voltage output pulse waveform, total delay time, and delay adjustment techniques. The 15 separate trigger pulses required can be derived from the present system uv pulser by addition of a 1:16 coaxial cable transformer.
Author (TAB)

N66-18646*# Dresser-HST, Garland, Tex. Environmental Lab.
MINIATURE TRANSFORMERS Test Report (Final), Sep. 1964–Apr. 1965
Charles E. Smith [1965] 117 p Prepared for JPL
(Contracts NAS7-100; JPL-950893)
(NASA-CR-70835) CFSTI: HC $4.00/MF $0.75 CSCL 09A

Qualification and environmental reliability test results are reported; and procedures, techniques, and equipment are described. Tests included: visual and mechanical examination; initial electrical measurements; frequency response tests; solder dip, lead bend, and twist tests; shock, vibration, moisture resistance, temperature cycling, and high temperature life tests; and final electrical measurements. A list is given of those components which failed, either catastrophically or parametrically, with probable causes. It is pointed out that the reliability tests are inconclusive due to excessive physical handling, to which components would not normally be subjected in circuit use. D.T.

N66-18661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MICROWAVE NOISE SOURCE OF GAS DISCHARGE FOR CIRCULAR WAVEGUIDES
Chuin-Sheng Lin and Shih-Wei Shu 1 Dec. 1965 18 p refs Transl. into ENGLISH from Tien Tzu Hsueh Pao (China), no. 1, 1964 1 23–30
(FTD-TT-65-359/1+2+3+4; AD-625261) CFSTI: HC $1.00/MF $0.50

The paper describes a new type of gas discharge tube which can be inserted horizontally into a circular waveguide to serve as a standard noise source. Operating in the 3-cm waveband with its terminal short-circuited, the discharge tube gives an excellent matching (VS-WR=1.10±0.05) to the waveguide system and has a stable noise output of 18±0.5 db. The result of the present investigation is applicable to the development of noise tubes of the waveguide type for the wavelength regions below 8 mm and above 10 cm. Author (TAB)

N66-18680# Army Foreign Science and Technology Center, Washington, D. C.
A PIEZOELECTRIC RESONATOR WITH A HEATING ELEMENT (SOVIET PATENT NO. 166745)
P. G. Pozdnyakov and E. G. Markosyan Dec. 1965 5 p Transl. into ENGLISH from Byul. Izobret. Tovarnykh Znakov (Moscow), no. 23, 1964
(FSTC-381-T65-594; AD-626048) CFSTI: HC $1.00/MF $0.50

The subject of the invention is a piezoelectric resonator with a heating element deposited directly on the surface of the piezoelectric resonator. To uniformly heat the whole surface of the resonator, piezoelectric resonator electrodes made in the form of a ribbon spiral and divided by insulating grooves are used as a heating element. Author (TAB)

N66-18685*# Westinghouse Electric Corp., Youngwood, Pa. Semiconductor Div.
[FABRICATION AND ENCAPSULATION OF TRANSISTORS AND COMPUTATION OF VOLTAGE CAPABILITY AND CURRENT GAIN] Second Quarterly Report, Oct.–Dec. 1965
Jan. 1966 29 p Prepared for JPL
(Contracts NAS7-100; JPL-951303)
(NASA-CR-70839) CFSTI: HC $2.00/MF $0.50 CSCL 09A

During the second quarter additional design calculations were made to compute the voltage capability and the current gain of the transistor. The epitaxial technique and the diffusion process were perfected. Most of the work on the encapsulation was completed. Three designs are under consideration. The details of these designs are given in the next section. Three groups of transistors were fabricated according to Design 1 and two groups of transistors were fabricated according to Designs 2 and 3. These transistors were encapsulated. The electrical characteristics are included in Sections II and III. Author

N66-18749# Iowa State Univ. of Science and Technology, Ames.
ELECTRONICS IN MASS SPECTROMETRY
Gerald D. Flesch and Harry J. Svec Jun. 1965 81 p
(Contract W-7405-ENG-82)
(IS-1193) CFSTI: HC $3.00/MF $0.75

A review of the fundamental behaviors of the electronic circuits involved in magnetic mass spectrometers is given in non-technical language. Emission regulated current supplies and ion current amplifiers are considered. Both vacuum tube and transistor circuits are discussed. The subject is presented in such way that one should be able to find somewhere in the compiled circuits, an example of most of the circuits usually found in commercial and home built instruments. Author(NSA)

N66-18769# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
A TRANSISTORIZED SWITCH FOR KALOUSEK POLAROGRAPHY
H. J. Fraser and T. M. Florence Jan. 1965 8 p refs
(AAEC/TM-279)

An improved switch was designed for the recording of Kalousek polarograms. The circuit is completely transistorized, and the switching rate can be varied over the range 2.5 to 35 cycles/sec by adjusting a ten-turn helical potentiometer. Frequency stability is better than ±0.5 percent in the ambient temperature range 0 to 55°C. Author (NSA)

N66-18793# European Atomic Energy Community, Brussels (Belgium). Joint Nuclear Research Center.
MULTIPLEX MEASURING SET-UP FOR REGISTERING SEVERAL MEASURING DATA VIA A SINGLE CABLE (E.G. ONE-WIRE COAXIAL CABLE) BY UTILIZING ONLY PASSIVE COMPONENTS (R, L, C) FOR MEASURAND CONVERSION ON THE INTAKE SIDE OF THE CABLE [MULTIPLEX-MESS-EINRICHTUNG ZUR ERFASSUNG MEHRERER MESSDATEN UBER EIN EINZIGES KABEL (Z.B. EINADRIGES KOAX-KABEL) BEI VERWENDUNG NUR PASSIVER BAUELEMENTE (R, L, C) ZUR MESSWERTWANDLUNG AUF DER EINGANGSSEITE DES KABELS]
W. Becker 1965 22 p ref In GERMAN
(EUR-2421.d)

It is shown that the principle of a measurement set-up allows the conversion of several slowly changing quantities (e.g., temperatures and mechanical deformations) by a transducer system in such a way that they can be transferred as electrical oscillations of certain frequencies, by means of a common high-frequency cable (e.g., coaxial cable) from the measurement to the evaluation room. Because of the nuclear radiations, the measurement area should only contain passive elements. The proposed set-up, therefore, mainly consists of an amplifier with positive feedback on the evaluation side, furnished with switchable frequency passbands. The definite oscillation frequency of this system is always determined by the resonant circuit in the measurement area tuned to a frequency inside the chosen passband. The resonant frequency of each of the resonant circuits in the measurement area is influenced by one of the quantities to be measured. It is necessary to reduce the means of transfer to one simple cable because difficulties arise as to hermetic sealing in leading several cables through the wall of the measurement container. The assembly is explained by some examples. Author (NSA)

N66-18856# Philips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
A TRANSISTORIZED BIDIRECTIONAL DECADE COUNTER
K. D. Smith Jan. 1965 18 p refs
(Contract AT(10-1)-205)
(IDO-17059) CFSTI: HC $1.00/MF $0.50

A transistorized bidirectional decade counter utilizing a binary and a quinary circuit is described. The elimination of feedback requirements, the minimization of the readout logic, and the symmetrical properties of the ten logical states produce an attractive counter. The logical design of the device is presented. The electrical equivalent circuit of the quinary is analyzed in detail and the conditions necessary for successful operation are described. Author (NSA)

N66-18861# Aktiebolaget Atomenergi, Stockholm (Sweden).
PHOTOMULTIPLIER TUBES FOR LOW-LEVEL CHERENKOV DETECTORS
O. Strindehag Mar. 1965 25 p refs
(AE-180)

Tube backgrounds of several 2-inch photomultiplier types having S11, 'S', S13, and S20 cathodes are compared by measuring signal and background pulse height distributions at pulse heights corresponding to a few photoelectrons. The reference signal is generated by means of a β source and a plexiglass radiator. It is found that comparatively good results are obtained with selected tubes of the EMI types 6097B and 9514B, having equivalent dark current d-c values down to 10^{-12} input lumens. Special interest is devoted to the correlation between the measured tube backgrounds and the dark current d-c values of the tubes, as a good correlation between these parameters simplifies the selection of photomultiplier tubes. The equivalent dark currents of the tested tubes extend over the range 10^{-12} to 10^{-9} input lumens. Although the investigation deals with photomultiplier tubes intended for use in low-level Cerenkov detectors, it is believed that the results could be valuable in other fields where photomultiplier tubes are utilized for the detection of weak light pulses. Author (NSA)

N66-19012# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MODULAR ELECTRONIC CIRCUITRY: POWER SUPPLIES [BUDOWA MODULOWEJ APARATURY ELEKTRONICZNEJ WEDLUG NORM RWPG (ZESTAW ZASILACZY)]
Jozef Kalisz May 1965 24 p refs In POLISH; ENGLISH summary
(INR-629/IA/PL) CFSTI: HC $1.00/MF $0.50

The main features of modular electronic blocks built according to CMEA standard are described. Some circuits of power supplies and their technical data are given. Author

N66-19036*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF SHUNT CAPACITANCE ON TRANSIENT EFFECTS CAUSED BY ELECTRON IRRADIATION OF A POLYETHYLENE TEREPHTHALATE INSULATED RIBBON WIRE
William E. Miller and Donald H. Phillips Washington, NASA, Mar. 1966 17 p refs
(NASA-TN-D-3321) CFSTI: HC $1.00/MF $0.50 CSCL 17B

An investigation of the effects of external "shunt" capacitance upon the electron irradiation induced voltage pulses from a 20.3-centimeter strip of polyethylene terephthalate insulated ribbon wire irradiated with 60 keV electrons is reported. Both the average and the maximum pulse heights observed varied inversely with the total capacitance in the system. A change in load resistance caused a negligible variation

in average and maximum pulse heights. After irradiation, electron discharge patterns known as Lichtenberg figures were found in the polyethylene terephthalate insulation. Rough calculations indicate that the power density along the discharge path is adequate to produce the observed physical damage. Author

N66-19045# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.

A PRODUCT ENGINEERING MEASURE FOR THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY AND TO IMPROVE PRODUCT CAPABILITY OF HIGH VOLTAGE MINIATURE SILICON RECTIFIERS Quarterly Progress Report, 30 Jun.–30 Sep. 1965

W. R. Comstock, N. E. Devolder, R. R. Schall, and E. G. Tefft [1965] 55 p refs

(Contract DA-36-039-AMC-06157(E))

(QPR-3; AD-626419)

The work reported during the report period includes: (1) the adoption of a 'standard' pellet design to use as a control for additional experiments, (2) the evaluation of pellet design experiments performed during the second quarter, (3) the optimization of the glassing process to yield acceptable devices, (4) the replacement of the copper lead wire material with copper alloy lead wire to obtain reliable welding to the device slugs, (5) results from the A 13 matrix testing through the 1000-hour readout, (6) the presentation of the Eyring Model for expressing failure rates, (7) modification of the proposed device specification, (8) use of a new switching speed circuit to better define recovery time, (9) the delivery of the Third Engineering Samples. TAB

N66-19148# Defence Research Telecommunications Establishment, Ottawa (Ontario). Electronics Lab.

A NEW FREQUENCY DOUBLER USING SEMICONDUCTOR DEVICES

D. P. Henderson May 1965 23 p

(DRTE-1138) CFSTI: HC $1.00/MF $0.50

A theoretical analysis of the mechanism for frequency doubler operation has indicated that semiconductor junctions are well suited for this application. This report includes a brief review of some common frequency doubler circuits from which it is generally concluded that they are somewhat unsuitable for variable amplitude signals and very wide band operation. A new frequency doubler circuit which employs four transistors and provides push-pull output signals is described. The device has a useful dynamic range in excess of 40 db and a frequency response from a few cycles to a megacycle, using the common 15 Mc/s alpha cut-off variety of transistors. Author

N66-19163# Centre National de Recherches de l'Espace, Brussels (Belgium).

LOW AND VERY LOW LEVEL DC AMPLIFIERS. PART III: MODULATORS AND DEMODULATORS

Paul Ville Jun. 1964 69 p *Its* Notes Preliminaires No. 43

CFSTI: HC $3.00/MF $0.75

Various types of modulation systems used for the amplification of d-c signals are discussed. The importance of the modulating technique lies in the fact that so far it is the method that yields the most accurate way to amplify low and very low level d-c signals. The following modulators are described in detail: electromechanical modulators (also called "electromechanical choppers"), electronic modulators, solid-state modulators, and magnetic modulators. M.R.W.

N66-19164# Centre National de Recherches de l'Espace, Brussels (Belgium).

LOW AND VERY LOW LEVEL DC AMPLIFIERS. PART V: LITERATURE AND REFERENCES

Paul Ville Jun. 1964 40 p refs *Its* Notes Preliminaires No. 45

CFSTI: HC $2.00/MF $0.50

A chronological list and abstracts of references which directly relate to the theory and design of low and very low level d-c amplifiers and modulators are presented. M.R.W.

N66-19233# Naval Ordnance Lab., White Oak, Md.

THE DEVELOPMENT OF THE FERROMAGNETIC MICROWAVE AMPLIFIER

Albert D. Krall and Edward T. Hooper, Jr. Dec. 1965 25 p refs

(NOLTR-65-187; AD-625750) CFSTI: HC $1.00/MF $0.50

The history and operation of the ferromagnetic microwave amplifier are briefly reviewed. A nonmathematical discussion of the various modulation processes involved in amplification is developed. The application of double pumping to the amplifier is treated as part of the modulation processes and a detailed description of an improved amplifier along with the experimental performance figure is given. Author (TAB)

N66-19235# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.

THE DEVELOPMENT AND EVALUATION OF A BILATERAL TROIDE SWITCH Final Report, 13 Apr. 1964–13 Oct. 1965

[1965] 187 p refs

(Contract NObsr-91151)

(AD-625769) CFSTI: HC $5.00/MF $1.00

This report describes the work performed toward the development of an improved bidirectional triode p-n-p-n switch. Qualitative and quantitative descriptions of the operation of the device are given. Calculations of the sheet conductivity of double-erfc-diffused layers and an extensive analysis of the effects of sheet resistance on the lateral current distribution in the two bases of p-n-p-n switch are presented. A model of the heat flow paths within the device is developed and its feasibility as well as its applicability to established computer-performed rating procedures is shown. The concept of commutating dv/dt is developed and its effect on the design of bidirectional triodes is considered. Device assembly techniques are discussed. Data concerning the effects of gold doping on the characteristics of the device, and a discussion of the characteristics of the state-of-the-art samples shipped during the fourth quarter are also presented. The features of the final design are described, especially those bearing on the dynamic properties of the device. Photoresist techniques as employed on this device are discussed. Author (TAB)

N66-19244# Piezo Crystal Co., Carlisle, Pa.

QUARTZ CRYSTAL UNITS, FILTER LOW FREQUENCY, 1 MC TO 10 MC Quarterly Progress Report, Jul.–Sep. 1965

Anthony S. Matistic 5 Nov. 1965 29 p refs

(Contract DA-36-039-AMC-03635(E))

(QPR-5; AD-625890) CFSTI: HC $2.00/MF $0.50

The report period was concerned with technical problems which required solution before preproduction samples could be fabricated. Actions which were introduced to resolve these technical difficulties were: submission and approval of a TAR to modify certain SCS-191 requirements (to render the mass loading technique compatible with requirements), mass loading experiments at problem frequencies 5 mc and

16 mc, and fabrication of prototype HC-6/U mounts to accommodate 0.600 inch diameter crystal blanks. Remaining time in the period was expended on fabrication and to the mounting operation of preproduction samples at frequencies 1.75 mc and 10 mc. Although much technical progress has been made, additional design refinements are required at frequencies 5 mc and 6 mc before preproduction samples will be fabricated at these 2 frequencies. Author (TAB)

N66-19264# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SYMMETRICAL FLIPFLOP
V. S. Il'yenko 8 Dec. 1965 6 p Transl. into ENGLISH from Russian Patent no. 162574 (Appl. no. 814977/26-9, 23 Jan. 1963) 2 p
(FTD-TT-65-1128/1+2+4; AD-625063) CFSTI: HC $1.00/MF $0.50

A symmetrical flipflop based on transistors with two inputs and with a common resistance in the emitter circuits is presented which has the distinguishing feature that for the purpose of eliminating the pseudo-operation of the breakdown of one of the transistors into each of its arms, there is connected in parallel a supplementary transistor apiece, while the bases of the latter are joined by cross connection with the collectors of the basic transistors. Author (TAB)

N66-19265# Naval Ordnance Lab., Corona, Calif.
STRUCTURAL MATERIAL DAMPING FOR PACKAGING ELECTRONIC COMPONENTS. TECHNIQUES USED FOR MISSILE FUZE COMPONENTS CAN BE ADAPTED FOR MANY PACKAGING APPLICATIONS
J. L. Day 1 Dec. 1965 32 p refs
(NAVWEPS-8810; AD-625717) CFSTI: HC $2.00/MF $0.50

Viscoelastic shear damping is being used to control the mechanical resonances of structures housing guided missile fuze components. Four experimental structures were fabricated using cast aluminum, laminated aluminum, laminated fiberglass, and aluminum honeycomb. They were subjected to acceleration, shock, temperature and humidity, and salt-spray tests. This report describes the housings and presents tests results. Author (TAB)

N66-19367# Varian Associates, Beverly, Mass. Quantum Electronics Div.
CESIUM BEAM TUBE RESEARCH Third Quarterly Progress Report, 1 Jul.–30 Sep. 1965
Joseph Holloway [1965] 18 p
(Contract DA-28-043-AMC-00464(E))
(Rept.-3; AD-627034) CFSTI: HC $1.00/MF $0.50

Progress was made on the completion of parts for the demountable beam tube test chamber, and experimental work was carried out on the deflection magnets and detector ion optics for this chamber. Parts for a microwave test cavity were nearly completed. Author

N66-19372# Radio Corp., of America, Somerville, N. J.
DEVELOPMENT OF INTEGRATED CIRCUITS UTILIZING COMPLEMENTARY TRANSISTORS Interim Development Report, 1 Oct.–31 Dec. 1965
A. H. Medwin et al [1965] 50 p
(Contract NObsr-93365)
(IDR-2; AD-627178) CFSTI: HC $2.00/MF $0.50

Installation of systems for the deposition of both doped and undoped layers of silicon dioxide was completed. Work on the preparation of substrates containing isolated n and p regions is slightly behind schedule, but some major obstacles were overcome. Preliminary design of the circuit was completed and a discussion of it is included in this report. Author (TAB)

N66-19376# McCoy Electronics Co., Mount Holly Springs, Pa.
PRODUCTION ENGINEERING MEASURE: MANUFACTURE OF GLASS HOLDER CRYSTAL UNITS TYPE CR(XM-66)/U Quarterly Progress Report, Jun.–Sep. 1965
[1965] 26 p refs
(Contract DA-36-039-AMC-06167(E))
(QPR-1; AD-626859) CFSTI: HC $2.00/MF $0.50

During the report period, the scheduling dates, production measures and the preliminary crystal design were agreed upon and action taken to execute them. The Flow Chart with the scheduling dates spelled out by the contract was submitted to the Contracting Officer and approval received. A crystal support design was agreed upon which would not contain any resonant points below 500 cps and still give satisfactory yield in meeting the Q requirement. The initial ordering and processing of the resonator was initiated and they are presently in the final stage of fabrication. Author (TAB)

N66-19387*# Moore-Peterson Associates, Santa Barbara, Calif.
SURVEY/STUDY OF THE INTERCONNECTION PROBLEM IN MICROELECTRONICS. CONCLUSION AND MANAGEMENT CONSIDERATIONS Final Report
Washington, NASA, Mar. 1966 56 p
(Contract NASw-919)
(NASA-CR-414) CFSTI: HC $3.00/MF $0.50 CSCL 09A

A survey study of the state-of-the-art of microelectronics emphasizing the interconnection problem, particularly as it relates to systems reliability, is presented. Information was received from numerous industrial organizations, from the military, and from NASA centers; and an attempt is made to determine the trends in the microcircuitry field, and to determine from these trends the weak spots or areas where further attention is warranted at the present time. Discussed are logic considerations; the multiple function chip; the multiple chip assembly; the microcircuit package; the multi-layer board; the interconnection bond; the connector; the systems design; component and systems reliability; and management considerations. L.S.

N66-19411# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 5, Jun. 30–Sep. 30, 1965
[1965] 57 p ref
(Contract DA-36-039-AMC-03632(E))
(TI-03-65-118; AD-626661) CFSTI: HC $3.00/MF $0.50

The preproduction phase of the manufacture of a (1.5 GHz to 3.0 GHz) germanium PEM device is progressing satisfactorily. All equipment necessary to manufacture the device has been installed, and is presently being used specifically for the purpose of training PEM personnel. The PEM process flow is described and accumulative yield curves are shown. Life test data on L-78 and L-78A devices after 4000 hours and 5000 hours are shown. Substantial progress was made toward eliminating the failure mode of PEM devices, type L-148 subjected to the soldering heat test. The primary failure mode is electrical opens. The number of devices exhibiting this type of failure mode was reduced by using larger bonding wire. The bonding

process is being investigated in order to obtain a bond with sufficient cross-sectional area so as to assure a lasting bond. A complete program was initiated in order to develop techniques for accurately determining the equivalent circuit of the L-148 chip. An approximate equivalent circuit of the L-148 chip is shown in this report. Diffusion and alloy furnaces temperature profiles were obtained and found to be satisfactory. TAB

N66-19434# Texas Instruments, Inc., Dallas.
MICROELECTRONIC FREQUENCY AND TIME STANDARD Final Engineering Report, Jul. 1–Nov. 5, 1965
Arlie D. Teel 15 Nov. 1965 32 p
(Contract NObsr-91352)
(U5-807250-5; AD-625316) CFSTI: HC $2.00/MF $0.50

The microelectronic frequency and time standard was completed. Because of several problems encountered during assembly and testing, shipment of the final equipment was delayed until 5 November 1965. The major problems occurred with the power output stage of the distribution-amplifier modules. These problems were not resolved because of fund limitations, although the solution required was determined. The standard frequency oscillators and all other parts of the equipment met every design requirement except crosstalk and noise rejection. It is significant to note that the purposes of the contract (i.e., to use semiconductor networks to the greatest possible extent and to meet or exceed design requirements with those networks) were met. The circuits not meeting specifications either did not contain semiconductor networks or did not meet specifications because of other circuit components, configuration, or design philosophy. Author (TAB)

N66-19463*# Radio Corp. of America, Princeton, N. J.
LAMINATED FERRITE MEMORY, PHASE I
R. Shahbender Washington, NASA, Mar. 1966 93 p refs
(Contract NASw-979)
(NASA-CR-398) CFSTI: HC $3.00/MF $0.75 CSCL 09A

This report describes the research performed in developing fabrication techniques to permit the assembly of a laminated ferrite stack of 4096×64 bits. For the assembled stack, a density in excess of 10^5 bits per cubic inch was demonstrated. Test data on individual arrays indicate bipolar sense signals of 1.5 mV for drain currents under 50 mA. Nuclear radiation studies conducted on ferrite samples indicate insignificant changes in magnetic and dielectric characteristics for dosages as high as 10^{19} nvt. For MOS transistors, the radiation studies indicate carrier mobility changes for dosages of 10^{16} nvt. Other changes, related to metallurgical processing, were observed as a result of the high ambient temperatures in the testing reactor. Author

N66-19535*# Southern Methodist Univ., Dallas, Tex.
N-PORT RECTANGULAR-SHAPED DISTRIBUTED RC NETWORKS
Y. Fu and J. S. Fu 14 Feb. 1966 26 p refs
(Grant NGR-44-007-006)
(NASA-CR-71091) CFSTI: HC $2.00/MF $0.50 CSCL 09C

A three layer structure consisting of a perfect dielectric sandwiched in between a resistive film and a pure conductor is considered as an n-port distributed RC network. It is pointed out that under certain conditions this structure can generate rational 2-port parameters. A simple derivation is used to establish a necessary and sufficient condition for 2-port parameters in a generalized n-port structure. D.T.

N66-19551# Arizona Univ., Tucson. Engineering Experiment Station.
THE EFFECT OF SIMULATED FISSION PRODUCTS IN THE INTER-ELECTRODE SPACING OF A THERMIONIC DIODE Annual Report, 1 Nov. 1964–1 Nov. 1965
Monte V. Davis 17 Dec. 1965 23 p refs
(Contract Nonr-2173(13))
(AR-1; AD-625586) CFSTI: HC $1.00/MF $0.50

The nuclear heating of in-core thermionic diodes to directly convert heat to electricity allows a compact, high-powered, long-lived system design. There are, however, some unanswered problems, one of which is the effect of admitting fission products into the interelectrode spaces of the system. This could happen in the case of a cladding rupture or by the impurities diffusing through the fuel from the hotter center to the surface of the fueled emitter. The effects of the fission products on the diode operation are considered. The materials representing fission products are individually introduced into the operating diode and the results compared to the theoretically determined model. The research has covered the effects of the noble gases argon, xenon, and krypton and of iodine on the operation of a planar thermionic diode. The effects of high temperature on the insulating properties of ceramic materials have been examined to delineate the problems of electrical breakdown that may occur in high powered thermionic reactor systems and to define safe areas of system temperature and voltages. TAB

N66-19563# Texas Instruments, Inc., Dallas.
LOW-NOISE L-BAND (WIDEBAND) TRANSISTOR AMPLIFIER Quarterly Technical Report No. 5, Jun. 1–Aug. 31, 1965
Leslie W. Read Oct. 1965 36 p refs
(Contract DA-28-043-AMC-00109(E))
(TI-03-65-108; AD-625766) CFSTI: HC $2.00/MF $0.50

This is a report of research and development leading to the fabrication of exploratory development models of extremely wideband transistor amplifiers at L-band frequencies. The work effort has been directed toward: (1) device characterization; (2) evaluation of coupler configurations; and (3) the fabrication and evaluation of a single-stage amplifier that uses two four-section branch-line couplers and transistors that are similar to the L-148a. The results of the work performed are: (1) the TI-line (Reg) package does not distort device characteristics too severely; and (2) the branch-line coupler may be too large for use in this program, and TEM couplers require less space but present fabrication problems because of line widths and spacing. The following conclusions have been drawn: (1) the TI-Line (Reg.) package is satisfactory for use at L-band frequencies; (2) further work is necessary before the best coupler configuration can be determined; and (3) the problem of gain compensation must be studied more intensively; the coupling should be tighter than 3 db at midband to hold the average VSWR at a minimum. Author (TAB)

N66-19613*# Georgia Inst. of Tech., Atlanta.
RC FILTERS WITH STAGGERED NOTCH FREQUENCIES
Kendall L. Su [1964] 13 p refs
(Grant NGR-11-002-020)
(NASA-CR-70927) CFSTI: HC $1.00/MF $0.50 CSCL 09A

A band-stop filter with a very narrow stop band can be produced by placing two RC distributed notch filters with slightly different notch frequencies in cascade. Design data, including stop-bandwidth, stop-band attenuation, and frequencies at several attenuation levels, are given. Some experimental results are also included. Author

N66-19637*# Southern Research Inst., Birmingham, Ala.
A STUDY OF WELDED CONNECTIONS IN CORDWOOD ELECTRONIC MODULES Final Report
J. D. Thornburgh 19 Jan. 1966 104 p
(Contract NAS8-20144)
(NASA-CR-71211) CFSTI: HC $4.00/MF $0.75 CSCL 09A

An experimental study was conducted of resistance welds between ribbon and wires as encountered in the cross-connections between stacked components of electronic modules. Using simulated modules, over 100,000 single welds were made, inspected, and tested to establish and document the prevailing defect rate in existing single weld construction. Only five of the single welds were defective, and none of these were catastrophic. To evaluate and compare redundant welds with single welds, about 2,000 double welds were made and 1,000 each of the first and second welds were tested. None of these welds were defective, but since the strength distributions for the single and double welds were comparable, the defect rate for the double welds was assumed to be the square of the single weld defect rate. Correlations were found with initial operator experience, the variability in the ribbon and some types of rejects and defects such as off-center; also, a relation was found between the current pattern obtained during welding and some major causes of failure such as off-center and corroded ribbon. Further, there was evidence that studies of the fillet and its composition may result in better welds. Author

N66-19639*# SDS Scientific Data Systems, Pomona, Calif.
FINAL SYSTEM TEST DATA FOR ANALYZER TUBE SERIAL 2C
[1965] 16 p
(Contract NAS5-3453)
(NASA-CR-71202; A7644) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Final system test results of the analyzer tube serial 2C are contained in this report. The analyzer was tested for sensitivity, resolution and top to base, ratio, percent of transmission from source, electron beam width, center frequency of each mass, filament power versus time, current distribution versus voltage, and recording of the operating potentials. Several filament changes were made during the performance of the tests. The final filament was a tungsten–rhenium alloy wire. Author

N66-19649*# VARO, Inc., Garland, Tex. Environmental Lab.
TOROIDAL TRANSFORMERS PROCEDURE 902-66-01 Final Report
John H. Mc Lin and Robert Winn 24 Dec. 1965 144 p Prepared for JPL
(Contracts NAS7-100; JPL-950989)
(NASA-CR-70923) CFSTI: HC $4.00/MF $1.00 CSCL 09A

Qualification test results are presented for encapsulated multi-secondary toroidal transformers and open-construction ratio toroidal transformers. The following tests were conducted: visual and mechanical examination, initial electrical, thermal sterilization, terminal pull, temperature rise, mechanical shock, vibration, moisture resistance, and temperature cycling. Tabulations are given of catastrophic failures, parametric failures, and exponential distribution parametric failure rates. Various graphs and results of failure analyses are included. C.T.C.

N66-19668# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
CURRENT DETECTORS FOR THE LINAC USING IMPULSE TRANSFORMERS [RIVELATORI DI CORRENTE PER IL LINAC CON TRANSFORMATORI DI IMPULSO]
G. Renzler 26 Oct. 1965 29 p refs In ITALIAN *Its* Nota Interna No. 293
(LNF-65/37) CFSTI: HC $2.00/MF $0.50

The detection circuit and toroidal magnet are described for the detection of electrons and positrons from the linear accelerator. Also, the equivalent circuit is shown and the physical characteristics and dimensions of the transformer and detection circuit are given. E.E.B.

N66-19695*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIVERSITY-LOCK PHASE DEMODULATOR
V. J. Di Losa Washington, NASA, Mar. 1966 17 p refs
(NASA-TN-D-3342) CFSTI: HC $1.00/MF $0.50 CSCL 09A

A synchronous demodulator utilizing the unique principle of diversity-lock has been developed for tracking and demodulating orthogonally polarized signals transmitted from satellites. For the first time, the well known principles of pre-detection diversity combining are applied to the phase-lock operation of a demodulator. Consequently, with independently fading signals the phase-lock performance is extended beyond present day carrier tracking demodulators. This unique feature is achieved by using three phase-lock tracking filters, one independent (primary loop) for tracking the doppler signal and two dependent (auxiliary loops) which provide signal coherence and weighting for combining. Since both auxiliary are automatically controlled by the primary loop, only the primary loop requires operating controls. This principle can be applied to a multi channel system with full diversity improvement and with essentially the same degree of operational simplicity as a two channel system. Author

N66-19756*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ULTRA-LOW-NOISE 1700-Mc PARAMETRIC AMPLIFIER SYSTEM
P. H. Dalle Mura Washington, NASA, Mar. 1966 20 p refs
(NASA-TN-D-3339) CFSTI: HC $0.25/MF $0.50 CSCL 09F

As the use of solid-state varactor parametric amplifiers have expanded to include a variety of ultra-sensitivity receiving systems, technological improvement has succeeded in decreasing the noise temperatures of these devices to a point, even operating in an environment heated above room temperature, approaching the theoretically minimum uncooled noise temperature. The paper describes a completely field-operational ultra-low-noise parametric amplifier achieving, at room temperature and above, noise temperatures previously attainable only by lowering the varactor temperature significantly below room temperature. Author

N66-19767# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
A HIGH-POWER SEMICONDUCTOR-MAGNETIC PULSE-GENERATOR CIRCUIT

Godfrey T. Coate and Laurence R. Swain Oct. 1965 158 p refs (Contract AF 33(615)-1139)
(ESL-R-246; AD-625825) CFSTI: HC $5.00/MF $1.00

A circuit for generating high-power, high-voltage pulse trains is described that uses silicon controlled rectifiers for high-current, low-voltage power switching, and inductors and transformers having saturable-magnetic cores for high-voltage, high-speed switching. Figures of merit for saturable-inductor switches and a measure of power-switching capacity for controlled rectifiers are determined which provide a characterization of these devices that is especially useful for design purposes. A step-by-step circuit-design procedure is presented that is flexible enough so that selected performance attributes (such as smallest size and weight, or highest efficiency) can be emphasized by the designer. A laboratory breadboard semiconductor-magnetic pulse generator producing 1700 average watts in 1.6-microsecond pulses of over 1 megawatt peak power is described as an illustration of the circuit technique. Author (TAB)

N66-19768# Army Electronics Labs., Fort Monmouth, N. J.
IMPROVED THIN-FILM CAPACITOR CHARACTERISTICS BY REANODIZATION Technical Report
Aubrey Raffalovich Dec. 1965 34 p refs
(ECOM-2635; AD-625531) CFSTI: HC $2.00/MF $0.50

A capacitor with improved electrical characteristics was fabricated by the reanodization of previously anodized tantalum films. The technique is simple. Comparative data was obtained between anodized and reanodized tantalum films. The tantalum was deposited by sputtering approximately 1000 Å of the metal onto glass substrates. The counter electrode was gold. The average voltage breakdown for the anodized samples was 60% of the formation voltage with 50% of all samples withstanding 70% V_F. With the reanodized samples, the average breakdown was 140% V_F; 50% of all samples withstanding 100% V_F and 11% withstanding 500% V_F. As a corollary, the current leakage characteristics of the reanodized samples were also improved. The reanodized samples showed good reverse polarity characteristics. There was a 10% improvement in capacitance and 15% improvement in the temperature coefficient of capacitance. There was no difference in dissipation factor, it being 1.3% for both processes. Author (TAB)

N66-19785# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT RADIATION INJURIES TO RADIO COMPONENTS IN A SHARP GAMMA-RADIATION FIELD
G. Aripov, Ye. M. Lobanov, and N. Shadiyev 25 Oct. 1965 7 p refs Transl. into ENGLISH from the Publ. "Radiatsionyye Effekty v Tverdykh Telakh" Tashkent, Akad. Nauk Uz. SSR, 1963 p 68–70
(FTD-TT-64-718/1+2+4; AD-625039) CFSTI: HC $1.00/MF $0.50

The effect of powerful dosages of gamma radiation on electric and mechanical properties of certain industrial capacitors with different dielectrics was investigated. The investigation covered mica, paper oil, electrolytic and ceramic capacitors. In order to eliminate the effect of conventional errors on the results, we tested several capacitors of each type and average the obtained data. The capacitance of the capacitors, leakage resistance, quality were measured prior and after radiation. The charge of the capacitors was determined at working voltage on them. TAB

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-18605# Army Foreign Science and Technology Center, Washington, D. C.
A BAND HYDRID COUPLING (SOVIET PATENT NO. 166390)
L. G. Maloratskiy Dec. 1965 5 p Transl. into ENGLISH from Byull. Izobretenii (Moscow), no. 22, 1964 p 31–32
(FSTC-381-T65-592; AD-626057) CFSTI: HC $1.00/MF $0.50

The subject of the invention is a band hybrid coupling on the basis of a multiloop directional coupler. To obtain great flexibility in the selection of operating parameters for the device, instead of connecting the central loop, a directional coupler with capacitance coupling is connected to it. Author (TAB)

N66-18660# Mitre Corp., Bedford, Mass.
A METHOD TO COMPUTE THE CHARACTERISTICS OF LUMPED ELECTROMAGNETIC DELAY LINES
Heinz B. Opladen Dec. 1965 23 p
(Contract AF 19(628)-2390)
(W-6324; ESD-TDR-64-628; AD-625733) CFSTI: HC $1.00/MF $0.50

This document presents a method of computing the coefficents of the transfer function of iterated or noniterated lumped electromagnetic delay lines. The method shows that the coefficients can be found by using Pascal's triangle for iterated delay lines. Author (TAB)

N66-19047 Joint Publications Research Service, Washington, D. C.
AXIOMATIZABLE CLASSES OF AUTOMATA
Heinz Kapkhengst *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 1–25 refs (See N66-19046 09-08) CFSTI: $6.00

Synthesis of a discrete action automata was studied for the case where given conditions are a type of axiom system defining a certain class. Algebraic fundamentals of the abstract automata theory were briefly discussed, and the concept of the Mealy automaton replaced by an algebraic bidolds concept. Automation possibility was developed from the concepts of bidolds for the topological group from the group concept. Also investigated was the event implication P→Q where P is the event in the input, and Q is the event in the output alphabet, and where it is possible to obtain all the corollaries in the meaningful sense from one set of implications. G.G.

N66-19048 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF AN AUTOMATON WITH RESPECT TO AN I' GRAMMAR
L. G. Samoylenko *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 26–30 refs (See N66-19046 09-08) CFSTI: $6.00

An algorithm for construction of automaton B according to an I' type grammar is proposed for the case where the finite automaton $A = A(G.X.\phi)$. $G(g_1, \ldots, g_1 b_1 \ldots b_n)$ is the set of the states of the automaton A. The state g_s $(1 \leq s \leq 1)$ of the given automaton corresponds to the variable symbol A_s^s of the given grammar, and the constant $b_r (1 \leq r \leq m)$ corresponds to the

constant symbol a_r of the given grammar. The developed construction shows that the automaton B represents the language as a set of events of states. G.G.

N66-19049 Joint Publications Research Service, Washington, D. C.

A SMALL DESIGN SYSTEM FOR DIGITAL AUTOMATON SYSTEMS

F. I. Andon, I. I. Brona, Ye. L. Voytova, and Yu. V. Kapitonova *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 31-37 refs (See N66-19046 09-08) CFSTI: $6.00

Described is the synthesis of a logical device through formation of a functional diagram by equations for the nodes of the combination system and the excitation functions for the excitations supplied at the inputs of the memory elements. Logical circuits of the Schaeffer stroke type were selected as combination systems and elements of the delay type for the memory. Programs for the device are divided into the following steps: (1) representation for the property of being an automaton; (2) synthesis of the transition matrix for the complete abstract automaton with respect to the representations; (3) minimization of the abstract automaton; (4) structural synthesis of the abstract automaton by delay elements; (5) minimization of the Boolean functions in the normal form; and (6) transition of the Boolean functions into notations of the generalized Schaeffer stroke and construction of the functional diagram. The algorithm for all steps during synthesis are described and the external characteristics of the programs are presented. G.G.

N66-19052 Joint Publications Research Service, Washington, D. C.

ON THE SYNTHESIS OF SYSTEMS WHICH REALIZE PARTIALLY DEFINED BOOLEAN FUNCTIONS

I. I. Brona *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 51-57 refs (See N66-19046 09-08) CFSTI: $6.00

The use of excitation functions in the synthesis of combination systems which realize partially defined Boolean functions was studied for the case where (a) the variable assumes the single value and then is obtained actually by three-valued logic, and (b) when it is indifferent whether the variable assumes the value of zero or one in the given case. G.G.

N66-19053 Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN THE THEORY OF SINGLE VALUED AND THRESHOLD FUNCTIONS

V. V. Litvinov *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 58-70 refs (See N66-19046 09-08) CFSTI: $6.00

Threshold element (TE) synthesis through construction of a threshold element which realizes a given function is determined by the weight of the threshold function. A condition of single valuedness of the Boolean function is necessary, but not sufficient for realization of the function in one TE. The relationship between the weights can be used to reduce the system of investigated inequalities so that each inequality can be expressed at minimal weight and the system of inequalities can be converted into a system of $m+1$ equations. ($m \leq n$). It was concluded that the compatibility of the systems of inequalities and the realization of the Boolean function in one TE makes it necessary that their system of equations has the unique solution $\lambda_i = 0$ $(1 \leq i \leq 1)$. G.G.

N66-19055 Joint Publications Research Service, Washington, D. C.

ON THE RELATIONSHIP BETWEEN AUTOMATA AND HALF-GROUPS

V. N. Red'ko *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 81-87 refs (See N66-19046 09-08) CFSTI: $6.00

Representation of abstract half-groups by computer logic was studied. An automaton without output A was considered a representative of the abstract half-group G if the half-group P(A) of the computer A was a homomorphic form of the half-group G. If the half-group P(A) was isomorphic to G, then the automaton A was an exact representation of the half-group G. Descriptions and classification of all representations of the abstract half-group G were described by a series of theorems which were a generalization of the known results for group representation by transitive substitutions. It was found that automata without outputs that belong to a finite abelien group and have a set of signals equivalent to the set of elements for this group, can be expanded into a direct product of finite numbers for simple cyclical group computers. G.G.

N66-19160# Centre Nationale de Recherches de l'Espace, Brussels (Belgium).

LOW AND VERY LOW LEVEL DC AMPLIFIERS. PART I: THEORY (I)

Paul Ville Nov. 1963 80 p ref *Its* Notes Preliminaires No. 35 CFSTI: HC $3.00/MF $0.75

Information about the theory and design of dc amplifiers is presented. The following areas are considered: dc amplification, noise in dc amplifiers, gain and zero stability, input and output resistance, cascaded and modulated amplifiers, input and output impedance, frequency response of modulated dc amplifiers, input transformer problem, and circuits for modulated dc amplifiers. M.R.W.

N66-19161# Centre National de Recherches de l'Espace, Brussels (Belgium).

LOW AND VERY LOW LEVEL DC AMPLIFIERS. PART II: THEORY (II)

Paul Ville Nov. 1963 113 p *Its* Notes Preliminaires No. 36 CFSTI: HC $4.00/MF $0.75

Basic theory of dc amplifiers is summarized. Discussed in detail are the following subjects: bridge-balanced dc amplifiers, compensated dc amplifiers, unusual circuits and techniques in dc amplifier design, and a transistorized direct-coupled low-level dc amplifier. M.R.W.

N66-19231# ITT Kellogg, Chicago, Ill.

INVESTIGATION OF FAULT DIAGNOSIS BY TRANSFER FUNCTION TECHNIQUES Final Report, 26 Oct. 1964-26 Sep. 1965

Walter J. Stahl, Thomas K. Mc Bride, John H. Maenpaa et al Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1965 119 p refs

(Contract AF 33(615)-2302)

(AFAPL-TR-65-113; AD-625587) CFSTI: HC $4.00/MF $0.75

The program under this contract was directed toward demonstrating the feasibility of fault diagnosis by transfer function techniques for linear electronic circuits. The objective was to be able to diagnose faults to the component level using only available input and output terminals and a minimum number of

internal test points. The methodology was to formulate and implement the theories, techniques and computer program required to generate a test procedure to diagnose a general class of linear electronic circuits. The technique investigated is that of observing changes in the breakpoint frequencies and amplitudes of the normal frequency response curves of the circuit under test and relating these changes to the faulty elements so that they may be diagnosed. The validity of this technique is based upon the fact that the breakpoint information together with the gain at any frequency serves to uniquely identify the transfer function of the system. The application of topological formulas to the generation of the symbolic transfer function of the circuit under test, and numerical evaluation of the generated function under normal and simulated failure conditions is the specific technique employed. Author (TAB)

N66-19408# Naval Ordnance Test Station, China Lake, Calif.
ANALYSIS OF RADIATION HAZARD NETWORKS USING ATTENUATION CONCEPTS Final Report
Russell N. Skeeters Nov. 1965 20 p refs
(NAVWEPS-8797; NOTS-TP-3900; AD-625663) CFSTI: HC $1.00/MF $0.50

The requirement for suppression of RF energy in ordnance ignition circuits may be stated in terms of the insertion loss of the network, which, inserted between the source (the equivalent generator) and the load (the resistance of the electroexplosive device, or EED), will limit RF energy at the EED to the tolerable level. The optimum theoretical treatment of RF suppression deals with the minimum of parameters and involves the minimum of mathematical difficulty. This report presents a method of analysis consistent with these goals. Simple formulas are given for computing insertion loss with a generator of known characteristics, and for computing the minimum insertion loss with a generator of variable or unknown characteristics. Author (TAB)

N66-19536*# Southern Methodist Univ., Dallas, Tex.
ANALYSIS OF RECTANGULAR RC DISTRIBUTED CIRCUITS WITH SHAPED ELECTRODES
K. W. Heizer 9 Feb. 1966 23 p refs
(Grant NGR-44-007-006)
(NASA-CR-71095) CFSTI: HC $1.00/MF $0.50 CSCL 09C

An analysis is given for a distributed RC network which consists of a resistive layer separated by an insulator from three separate electrodes. A conducting tab is placed completely across two opposing ends of the resistive layer. These tabs form two terminals of a five-terminal network. The three electrodes form the other terminals. The short circuit admittance parameters for this network are derived and consideration is given to special interconnections. The short circuit transfer admittances between an electrode and either end of the resistive layer may easily be made rational. An interconnection provides the possibility of a rational short circuit transfer admittance which does not possess a zero at the origin. The method can be extended to similar multielectrode networks. Author

N66-19747# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrophysics.
MEASUREMENT TECHNIQUES FOR OVERSIZED WAVEGUIDE
B. L. Gupta 23 Nov. 1965 54 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1299-65; AD-625452) CFSTI: HC $3.00/MF $0.50

The first phase of this work is concerned with the identification as well as estimating the power coupling of spurious modes in the presence of TE10, the main mode in the over-moded waveguide. The second phase would consider the measurement of known or approximately known discontinuities such as dielectric slabs and capacitive irises or steps. Precision experimental procedure carried out enables the measurement of spurious modes coupled more than 25 db below the main mode. The dielectric constant evaluated from the experimental results was surprisingly close to the previously measured and specified value. The device under study is a 6 inch square overmoded waveguide fed by a sequence of long rectangular tapers from standard S, C and X band waveguides. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-18509# Geotechnical Corp., Garland, Tex.
OPERATION OF THREE OBSERVATORIES Final Report, 1 Jul. 1963-30 Apr. 1965
[1965] 334 p
(Contract AF 33(657)-12373; ARPA Order 140-60)
(TR-65-58; AD-625516) CFSTI: HC $7.00/MF $1.50

The operation of the Blue Mountains Seismological Observatory, Cumberland Plateau Seismological Observatory, and Uinta Basin Seismological Observatory between 1 July 1963 and 30 April 1965 is discussed in this report. Modifications and additions to the observatory instrumentation are described and tests to improve the operation of the observatories are reported. Also discussed in the report is the progress of special investigations designed to evaluate and improve the detection capability of the observatories. Author (TAB)

N66-18595# Army Electronics Labs., Fort Monmouth, N. J.
MODEM TESTING WITH A MULTIPATH TRANSMISSION SIMULATOR
Elis D. Hanson Sep. 1965 21 p
(ECOM-2633; AD-625853) CFSTI: HC $1.00/MF $0.50

This report covers the results of several 'on the bench' tests performed on engineering test models of modulator-demodulator MD-515. The MD-515 is a 12 channel, phase shift keyed (psk) data modem designed to operate at either 2400 or 1200 bps. In the 1200 bps mode, the option of either inband frequency diversity or double band length signaling elements is available. The first series of tests involved the use of a multipath transmission simulator to evaluate the performance of the modem under controlled conditions of selective fading and phase perturbations. Other tests were performed by adding noise to the line signal to measure the error rate vs signal-to-noise ratio, the dynamic range of the equipment and the effect of peak limiting the line signal prior to transmission. A brief description of the modem and the simulator are included in the report. Author (TAB)

N66-18696# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

A SYMMETRIC SYSTEM OF WIRE ELECTRODES FOR AN ISOTROPIC SPARK CHAMBER [SIMMETRICHNAYA SISTEMA PROVOLOCHNYKH ELEKTRODOV IZOTROPNOI ISKROVOI KAMERY]

A. T. Matyushin and V. T. Matyushin 1965 12 p refs In RUSSIAN
(JINR-P-2312)

Possibilities of optimization in the construction of an isotropic spark chamber are considered. It is shown that the chamber with a symmetric system of wire electrodes has some advantages over an open system and provides great accuracy in determining the track coordinates, in particular z-projection. Author (NSA)

N66-18697# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

WIRE SPARK CHAMBER WITH EXTERNAL ACOUSTIC TRANSDUCERS [PROVOLOCHNAYA ISKROVAYA KAMERA S VNESHNIMI AKUSTICHESKIMI DATCHIKAMI]

P. Ambro, Yu. A. Karzhavin, V. G. Matyushin, A. T. Matyushin, and P. Shoshev 1965 7p refs In RUSSIAN
(JINR-P-2368)

A wire filmless chamber is described in which the Cartesian coordinates of the spark are recorded with external acoustic transducers. Such a chamber allows to record simultaneously several sparks arising in the discharge gas. Author (NSA)

N66-19139*# Conductron Corp., Ann Arbor, Mich.

RADOME FACILITY Final Report

[1965] 133 p refs *Its* Rept.-0038-RF-1
(Contract NAS5-3232)
(NASA-CR-70821) CFSTI: HC $4.00/MF $1.00 CSCL 14B

The construction, installation, and checkout of a radome measurement facility are reported. The purpose of the radome is to provide a capability for measuring the microwave reflection and transmission characteristics of passive communications satellite materials. A theoretical and experimental evaluation was made of the electrical properties of the radome and their effects on measurements. Included in the evaluation were a determination of reflection coefficients for various materials, and an investigation of high frequency scattering from a conducting sphere surrounded by a thin wall radome. The possibility of using the radome as housing for a transmitting antenna is discussed; and the test fixtures are described along with the instrumentation systems. Extensive support facility and test fixture drawings are also presented. D.T.

N66-19629*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

JPL SPACECRAFT STERILIZATION TECHNOLOGY PROGRAM: A STATUS REPORT

D. Drummond and V. Magistrale 31 Dec. 1965 116 p refs
(Contract NAS7-100)
(NASA-CR-71186; JPL-TR-32-853) CFSTI: HC $4.00/MF $0.75 CSCL 22D

This document presents the technical status of a spacecraft sterilization program including hardware development, physical plant design and development, and sterilization technology research and development. Author

N66-19630*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

COMMENTS ON THE OPERATION OF THE JPL 25-FT SPACE SIMULATOR

George G. Goranson 25 Jan. 1966 23 p refs
(Contract NAS7-100)
(NASA-CR-71205; JPL-TR-32-885) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A 25-ft space simulator has been used continuously during 1963 and 1964 for tests of Ranger, Mariner, and Surveyor spacecraft. Comments are made concerning the importance of combined solar and space simulation to the flight projects. Problems, which are peculiar to the operation of a large space simulator, are discussed. Author

N66-19646*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HISTORY OF THE GEORGE C. MARSHALL SPACE FLIGHT CENTER FROM JANUARY 1-JUNE 30, 1964, VOLUME ONE

David S. Akens, Leo L. Jones, and A. Ruth Jarrell May 1965 299 p refs
(NASA-TM-X-57307; MHM-9, Vol. 1) CFSTI: HC $6.00/MF $1.50 CSCL 22D

A description is given of the most historic events at the George C. Marshall Space Flight Center during the period January 1 through June 30, 1964. Emphasis is placed on research and development with the Saturn I, IB, and V vehicles. Various photographs of the facility and activities at the facility are included. C.T.C.

N66-19709*# Bell Aerosystems Co., Buffalo, N. Y.

STUDY OF MODIFICATION OF A LUNAR LANDING RESEARCH VEHICLE TO A LUNAR LANDING TRAINING VEHICLE

J. Ryken 28 Jan. 1966 74 p
(Contract NAS4-981)
(NASA-CR-71253) CFSTI: HC $3.00/MF $0.75 CSCL 22D

The changes which should be made to progress from the existing design of LLRV to LLTV suitable for astronaut training are discussed. Major conclusions were that an adequate simulation of the pilots field of view from LEM can be achieved while retaining the seated position for the pilot; some redesign and repackaging of electronics systems would significantly reduce maintenance and checkout time of these systems; and a structural redesign of the jet engine gimbal and other local areas would be desirable to increase rigidity and simplify manufacture. Several secondary improvements, primarily to simplify servicing, checkout, and maintenance, were also noted. E.E.B.

N66-19712*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.

SURVEYOR LUNAR ROVING VEHICLE, PHASE I. VOLUME II: APPENDIXES; SECTION I: CONCEPT EVALUATION AND ANALYSIS Final Report

23 Apr. 1964 389 p Prepared for JPL
(Contracts NAS7-100; JPL-950657)
(NASA-CR-71261; TR64-26, Vol. II, Section I) CFSTI: HC $7.00/MF $2.00 CSCL 22D

Presented are the following appendices: lunar operating plan; mission gaming; lunar surface physical characteristics; photometric analysis of the lunar surface; photogrammetric and photometric investigations of contour mapping; collection

capability of television; statistical estimation of certifiability; effects of stereoscopic, monoscopic, and triangulation techniques in guidance and topographical survey; configuration equilibrium thermal analysis; operating sequences and power profiles; performance analysis of survey functions; mobility-weight tradeoff analysis; and power–weight tradeoff analysis.
E.E.B.

N66-19713*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
SURVEYOR LUNAR ROVING VEHICLE, PHASE I. VOLUME II: APPENDIXES; SECTION III: MECHANICAL SUBSYSTEMS Final Report
23 Apr. 1964 462 p Prepared for JPL
(Contracts NAS7-100; JPL-950657)
(NASA-CR-71260; TR64-26, Vol. II, Sect. III) CFSTI: HC $7.62/MF $2.25 CSCL 22D

Mobility, structures, mechanisms, models, and locomotion evaluation and vehicle concept selection are covered in this volume of the Surveyor study.
E.E.B.

N66-19714# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
EVALUATION OF ILS CHECK LIGHT SYSTEM Final Report
Richard W. Cleary Jun. 1965 22 p
(RD-65-75)

An optical system for flight checking the Instrument Landing System (ILS) was evaluated in order to determine the utility of such a system as a source of position information during ILS flight checks. Two beams of light were projected. The top edge of one beam was aligned with the ILS glide slope; the right edge of the other beam was aligned with the runway centerline. A flight check aircraft was navigated along these paths by visual reference to the light source. The accuracy with which an observer in the aircraft could identify the centerline and glide path by observing the check light was determined. Although the ILS check light system performed in accordance with the original design requirements, it was determined that this system was unsuitable in meeting the new ILS flight check requirements and it was recommended that the system not be adopted for operational use.
Author

N66-19724# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
EVALUATION OF RUNWAY LIGHTING SYSTEMS FOR EFFECTIVENESS IN DENSE FOG Final Report
D. M. Finch, R. Horonjeff, and H. G. Paula Jan. 1966 264 p refs
(Contract FAA-ARDS-434)
(RD-65-58)

Tests of runway lighting systems in dense fog show that an intensity of 200 to 300 cp, now in general use for centerline lights at U.S. airports, is not high enough for effective guidance in a fog density of 1200-ft visual range, day or night. These tests also indicate that in daytime, with a 1200-ft visual range, runway marking is considerably useful to pilots as a supplement to runway lighting. In addition, on the basis of pilots' reactions, the present U.S. standard pattern (3:3:3) for touchdown-zone and centerline lights was found to be more effective than either of two other patterns (3:2:1 and 7:3:1) evaluated. Pilots also preferred a modified version of the present U.S. standard approach-light system. The tests were performed in a specially designed facility using artifically produced fog and a linear scale reduction factor of 1/10. Evaluations were made from pilot observations, as well as photometric measurement and photographic techniques. The test facilities and methods are described, the test results are presented, and some of the influencing factors, such as background brightness and cockpit cutoff angle, are discussed. In addition, a number of recommendations are made with regard to intensities and photometric distributions for runway lights, and with respect to changes in the present U.S. standard approach light system.
Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-18521# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW OF A NON-ADIABATIC SUPERSONIC FLOW OF AN IDEAL GAS AROUND A FLAT PLATE
I. F. Shakhnov 8 Dec. 1965 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSR, Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 154–157
(FTD-TT-65-1122/1+2+4; AD-625061) CFSTI: HC $1.00/MF $0.50

A discussion is given of the flow around a flat plate with a supersonic flow of an ideal gas in the presence of a heat generation zone connected with current lines and adjoining a surface of a plate. It is assumed that the rate of heat generation is proportional to the rate of fuel combustion calculated by the summary kinetic equation of certain power with a temperature dependence according to Arrhenius' Law. It is also assumed that in initial section the flow appears to be uniformly advancing and that the fuel in this section is uniformly mixed with air to the storcheometric ratio.
TAB

N66-18565# Harry Diamond Labs., Washington, D. C.
FLUERICS (FLUID AMPLIFICATION) Bibliography
30 Aug. 1965 158 p refs
(TR-1304; AD-625885) CFSTI: HC $5.00/MF $1.00

A bibliography of flueric (fluid amplifier) devices and theory is presented with abstracts for the majority. The bibliography includes 376 titles on fluid devices, fluid circuits, sensors and transducers, instrumentation and flow visualization, fabrication, patents and disclosures, and other directly applicable technology. It also includes titles on related topics such as jets; vortex flow; pipes, passages, and diffusers; and vibration and acoustic effects.
Author (TAB)

N66-18625# TRG, Inc., Melville, N. Y.
WAVE-WAKE INTERACTION Final Report
Jerome R. Lurye and Jack Kotik Nov. 1965 45 p refs
(Contract Nonr-4682(00))
(TRG-036-FR; AD-626158) CFSTI: HC $2.00/MF $0.50

The report is concerned with the complicating effects of the viscous wake on the problem of defining and determining the wave resistance of a ship in a real fluid. Discussions of a number of topics bearing on this problem are given. In the

first of these, an idealized wake model is introduced to show how the wake can invalidate the usual ideal fluid wave-survey formulas for wave resistance. The second analyzes the problem of a plane surface wave incident upon a uniform stream of semi-infinite width from a region of stationary fluid, the latter being in contact with the stream along a vertical plane. Critical reflection angles are found, while the determination of the reflection and transmission coefficients is proved equivalent to the solution of a certain functional equation for the Fourier transforms of the velocity potentials. In the final discussion, examples are given of the modeling of a body plus its wake with ideal flows generated by simple distributions of singularities. Author (TAB)

N66-18662# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDRAULIC RESISTANCE AND HEAT AND MASS TRANSFER IN A VORTICAL FLOW

R. Z. Alimov 19 Oct. 1965 19 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 3, 1965 p 81-85
(FTD-TT-66-937/1+2+4; AD-625289) CFSTI: HC $1.00/MF $0.50

The article introduces the results of experimental investigation of heat and mass transfer at different degrees of vorticity of a flow applicable to a tube 200 mm in diameter and 2 m long. Author (TAB)

N66-18744# Sandia Corp., Albuquerque, N. Mex.

STATIC PRESSURES ON CONE-CYLINDERS IN SLIP-TO TRANSITION FLOWS

K. J. Touryan Jan. 1965 23 p refs
(Contract AT(29-1)-789)
(SC-RR-65-1689) CFSTI: HC $1.00/MF $0.50

Static pressures on 50-degree-cone-cylinder probes have been measured in a 1.0 to 11.0 Mach range. Free stream Knudsen numbers $0.01 < Kn_D > 10$ (corresponding free flight altitude range, 200,000 to 450,000 feet) were measured at various locations aft of the cone-cylinder joint. Various rarefaction effects are studied and pressure data are correlated with respect ot a modified interaction parameter, x_L, which ranges from 0.1 to 500. Author (NSA)

N66-18783# Los Alamos Scientific Lab., N. Mex.

STABILITY OF DETONATIONS FOR DISTURBANCES OF SMALL TRANSVERSE WAVELENGTH

Jerome J. Erpenbeck 3 Aug. 1965 136 p refs
(Contract W-7405-ENG-36)
(LA-3306) CFSTI: HC $4.00/MF $1.00

The stability of one-dimensional, steady detonations to periodic disturbances transverse to the flow is examined in the limit of small wavelength, i.e., $2\pi/\epsilon \to 0$. It is found that any unstable disturbance grows in time. The asymptotic criterion for stability is found to depend largely upon the steady-state profile of $c_0 - u^2$ (where c_0 is the frozen sound speed and u is the mass velocity relative to the von Neumann shock) as a function of distance behind the shock. Detonations for which $c_0 - u^2$ decreases monotonically are found to be stable (in the $\epsilon \to \infty$ limit), but stability in cases in which this quantity increases either monotonically or up to a maximum (and decreases beyond) is determined through simple integral functions of the steady-flow variables. The asymptotic result can be readily applied to any detonation, irrespective of the number of chemical reactions which occur, provided knowledge of the equation of state and reaction kinetics is at hand. The criterion is applied to an idealized, one-reaction detonation. Unstable regimes are found only if the ratio of specific heats is less than 2, for which case all detonations are found to be unstable for sufficiently large values of the activation energy. For low heats of reaction, it is found that instability persists for all (positive) heats, unless the activation energy is also small. On the other hand, for more realistic heats of reaction, the criterion predicts stability for small activation energies. Author (NSA)

12

N66-18824# Los Alamos Scientific Lab., N. Mex.

HASTI: A NUMERICAL CALCULATION OF TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMICS UTILIZING THE CONCEPT OF SPACE-DEPENDENT TIME STEPS

Phillip L. Browne and Martha S. Hoyt 5 May 1965 24 p refs Submitted for Publication
(Contract W-7405-ENG-36)
(LA-3324) CFSTI: HC $2.00/MF $0.50

A numerical experiment is described in which an attempt was made to reduce the calculation time of a two-dimensional, Lagrangian, hydrodynamics code, without loss of accuracy. The reduction was accomplished by utilizing a space-dependent time step; i.e., the frequency with which a point is calculated depends on the rate at which changes are occurring in the vicinity of the point. This system permitted savings to be made by eliminating calculations in regions undergoing relatively slow changes. Author (NSA)

N66-18846# Mechanical Technology, Inc., Latham, N. Y.

A THEORY FOR TURBULENT FLUID FILMS AND ITS APPLICATION TO BEARINGS

H. G. Elrod, Jr., C. W. Ng, and C. H. T. Pan Mar. 1965 73 p refs
(Contract AT(30-1)-3363)
(NYO-3363-2; MTI-65TR9) CFSTI: HC $2.00/MF $0.75

A new turbulent lubrication analysis was derived which takes into account certain well-established facts concerning turbulent shear flow. Consistent with lubrication-film theory, the nature of the local flow is taken to depend only on local film thickness, surface velocity, and pressure gradients. An eddy diffusivity treatment is used which incorporates the "law of wall" with the use of local (within the film) shear stress. Stress reversal phenomena are accommodated, and isotropy of the turbulent exchange mechanism in the plane of the film is assured. Coefficients are developed for use in the generalized Reynolds (lubrication) equation, and computation procedures for the static and dynamic characteristics of turbulent, self-acting bearings have been prepared. The non-linear effects due to the coupling of the shear-induced flows and the flows due to the circumferential and axial pressure gradients are fully considered in this analysis. Thus, it is anticipated that it, unlike the previous linearized analysis, is directly applicable also to turbulent, externally pressurized and hybrid bearings. Author (NSA)

N66-18864# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes (France). Division Atomiques.

PROGRESS OF WORK DURING THE FOURTH QUARTER 1964 Quarterly Report No. 19

C. Moussez 11 Jan. 1965 9 p Transl. into ENGLISH from French
(Contract EURATOM-061-64-7TEEF)
(EURAEC-1288) CFSTI: HC $1.00/MF $0.50

Progress is reported in measurements of 20 mm-dia. circular channel pressure drop, flow quality, and corrosion film thickness. Tests on a 2-channel cruciform section are discussed. Thermal studies on a 20-mm circular section with evolutive flux are discussed along with studies on a test section with direct heating by Joule effect. A test section with nine heating rods was designed. NSA

N66-18874# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
A PROGRAM OF TWO-PHASE FLOW INVESTIGATION Seventh Quarterly Report, Oct.–Dec. 1964
G. Bijwaard, F. W. Staub, and N. Zuber 10 Jan. 1965 96 p refs
(Contract AT(04-3)-189)
(GEAP-4778; EURAEC-1326) CFSTI: HC $3.00/MF $0.75

The results of the analytical investigations which have been carried out during the first contract year are summarized. Additional still and high-speed motion picture photography was carried out at constant heat input in the glass test section. Nucleation in the annular flow regime was studied in this photography work. Subsequent to the installation and checkout of the new condenser, the oscillatory heat input tests were initiated on schedule in the metal test section. To date, all the planned tests at a reduced pressure of 0.25 have been completed as well as about 40% of those at a reduced pressure of 0.12. Only the information at the higher reduced pressure is discussed. The method of transient void data reduction is also discussed. A propagation equation is presented which describes the transient behavior of the vapor volumetric concentration in a two-phase flow system with a change of phase. This propagation equation, which is formulated in terms of kinematic waves, predicts the void response to variations of: (1) power density, (2) pressure, (3) pressure drop, (4) energy storage in the liquid and in the vapor, (5) compressibilities of the liquid and of the vapor, (6) friction factor, (7) flow regime, and (8) gravitational force field. The results of the analysis show that: (1) The rate of propagation of the voids, as well as the change, i.e., the distortion of the void disturbance as it propagates along the duct, can be predicted by means of kinematic waves. (2) The void response can be predicted if the steady state voids can be predicted. (3) The void response depends, definitely, upon the flow regime, and it may change, completely, with a change in flow pattern. (4) A change in two-phase flow pattern may occur whenever variation of voids cannot propagate through the mixture. (5) The void propagation equation, together with the momentum, energy, and continuity equations for the mixture, and with the equation of state, describes the dynamic behavior of the system. The results, predicted by the void propagation equation, are in the process of being compared to experimental data. NSA

N66-18876# Los Alamos Scientific Lab., N. Mex.
PHERMEX APPLICATIONS TO STUDIES OF DETONATION WAVES AND SHOCK WAVES
Douglas Venable and T. J. Boyd, Jr. [1965] 43 p refs Presented at the 4th Symp. on Detonation, Silver Spring, Md.
(Contract W-7405-ENG-36)
(LA-DC-6996; CONF-651003-1) CFSTI: HC $2.00/MF $0.50

A 20-Mev, high intensity, high current, flash radiographic machine, PHERMEX, was built to complement other hydrodynamics facilities of the Los Alamos Scientific Laboratory. In many experimental situations, observations of hydrodynamic phenomena may be obtained by means of techniques unique to flash radiography. This device is used primarily to implement studies in areas related to detonation and shock waves, jet formation and the interaction of jets with matter, spalling and cratering. In certain simple geometries, shock wave and rarefaction wave velocities, particle velocities, and time variation of both edge positions and mass density distributions can be obtained. This facility and the choice of its design parameters are discussed. Radiographs illustrating typical experiments are included. Results of several experiments are presented; these include measurements of the Hugoniot pressure at zero particle velocity, and the particle velocity and sound speed behind a detonation wave in solid explosives. Author (NSA)

N66-19099# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
THE INFLUENCE OF PRESSURE GRADIENT ON THE TURBULENT BOUNDARY LAYER OVER A ROUGH SURFACE
Victor E. Scottron and John L. Power Dec. 1965 63 p refs
(DTMB-2115; AD-626086) CFSTI: HC $3.00/MF $0.75

The boundary layers produced on rough surfaces in adverse pressure gradients have been investigated. This report contains experimental results obtained for a single surface roughness at three pressure conditions: one at constant pressure and two having adverse pressure gradients. The mean velocity profiles in the boundary layer have been measured by both Pitot tubes and hot wires. The longitudinal turbulence intensities were measured with a hot wire. The pertinent boundary layer parameters have been calculated and are presented. Results have been compared with available smooth wall data. Author

N66-19178# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
THE DEVELOPMENT OF AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER IN AN ARBITRARY PRESSURE GRADIENT
Frank J. Zwarts Oct. 1965 51 p refs
(Grant DRB-G-9550-06)
(Rept.-65-7) CFSTI: HC $3.00/MF $0.50

A theoretical analysis of the incompressible boundary layer in an arbitrary pressure gradient was undertaken. The wall similarity law was used for the inner layer, while the constant eddy viscosity concept was extended to nonequilibrium flow for the outer layer. The shear stress, velocity and first derivative of the velocity were matched, and a computer program developed to calculate the parameters. The method was compared to a limited number of experimental boundary layers of diverse character. Good agreement was found for separating, equilibrium and recovering turbulent boundary layer flows, and accurate information was found on velocity and shear stress. N.E.N.

N66-19228# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFERENTIAL METHOD FOR THE NUMERICAL SOLUTION OF TWO DIMENSIONAL NON-STATIONARY NAVIER-STOKES EQUATIONS FOR A COMPRESSIBLE GAS
I. Yu. Brailovskaya 8 Dec. 1965 11 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 5, 1965 p 1042–1045
(FTD-TT-65-1107/1+2+4; AD-625058) CFSTI: HC $1.00/MF $0.50

The present article describes a differential method of computing two dimensional nonstationary flow of a viscid compressible gas with variable coefficients of viscosity and heat conductivity. This method was used in the computation of stationary flow in a rectangular pocket when the upper boundary of the pocket moves with constant velocity. The production of stationary distribution of temperature, of density and of velocity was the result of the findings established with this method of substantiation. Author

N66-19487# Royal Aircraft Establishment, Farnborough (England).

AN EXPERIMENTAL INVESTIGATION OF THE FLOW THROUGH INCLINED CIRCULAR TUBES AT A MACH NUMBER OF 4.0

P. L. Roe May 1965 50 p refs

(RAE-TR-65110)

Pressure plotting experiments have been performed on the internal flow through inclined circular tubes at M=4, and the results used to investigate both the nature of the flow and the internal forces. It is intended to apply the results to the wind tunnel testing of models with nacelles. Linear theory calculations have been made and the predicted forces are in good agreement with experimental values, provided the ducts are short. Author

N66-19489*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SPECTRUM-LINE REVERSAL MEASUREMENTS OF FREE ELECTRON AND COUPLED N_2 VIBRATIONAL TEMPERATURES IN EXPANSION FLOWS

I. R. Hurle and A. L. Russo Jan. 1965 39 p refs Submitted for Publication

(Contract NASr-109)

(NASA-CR-60857) CFSTI: HC $2.00/MF $0.50 CSCL 01A

Descriptions are given of spectrum line measurements of the excitation temperature of Na atoms in expansion flows of shock heated Ar and Ar+1% N_2 mixtures. The measurements were made in a conical nozzle attached to the end of a conventional shock tube. For expansion flows of pure Ar from reservoir temperatures of 3200° K to 4200° K and a reservoir pressure of about 37 atm, the measured Na temperatures (≈2200° K) were considerably in excess of the local translational temperature (≈400°K). These high excitation temperatures are interpreted in terms of the excitation of Na by free electrons produced from ionization of the Na in the reservoir. On this basis, free electron temperatures are deduced which indicate freezing of the electron thermal energy at values corresponding to those expected at the nozzle throat. The addition of 1% N_2 to the Ar expansions produced large reductions in the measured Na temperatures. These results substantiate the faster vibrational relaxation rates inferred previously from similar expansion flow studies of pure N_2. C.T.C.

N66-19492*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TURBULENT COAXIAL MIXING OF DISSIMILAR GASES AT NEARLY EQUAL STREAM VELOCITIES

Robert G. Ragsdale and Oliver J. Edwards [1964] 29 p refs Presented at the Heat Transfer and Fluid Mech. Inst., Los Angeles, 21–23 Jun. 1965

(NASA-TM-X-52082) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An analytical and experimental study is made of the isothermal turbulent mixing that ensues when one gas is injected coaxially into a stream of another gas that is moving in the same direction at a comparable velocity. These investigations have resulted in a number of proposed formulations for the dependence of turbulent viscosity on geometry, flow, and physical-property parameters. The various expressions for turbulent viscosity are compared in this paper on a consistent basis. It is shown that the different equations predict essentially the same eddy viscosity within certain ranges of stream velocity ratios and density ratios. Considerable divergence of results occurs, however, when a given equation is applied beyond the range of experimental conditions for which it has been verified. Some of the proposed expressions include an axial dependence of the turbulent viscosity. Previously published data are compared with theory for three different assumed variations of eddy viscosity with axial position. It is shown that, for nearly equal stream velocities, the eddy viscosity can be taken as constant in both the radial and axial directions. Author

N66-19503# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

LIQUID MASS TRANSFER IN ANNULAR TWO-PHASE FLOW

L. B. Cousins, W. H. Denton, and G. F. Hewitt May 1965 50 p refs

(AERE-R-4926)

Three aspects of mass transfer of entrained liquid in annular air–water flow in a 0.375 in bore tube at inlet column pressures of 25 to 40 psia, have been studied, namely: unidirectional mass transfer of liquid out of the liquid film into the gas core as the flow proceeds along the tube, interchange between the liquid flowing in the liquid film and that flowing in the gas phase, and deposition of the entrained liquid subsequent to the complete removal of the liquid film. The studies of entrainment revealed that the minimum liquid rate necessary for entrainment fell to an approximately constant value with increasing gas flowrate and there were strong indications that, at least for the lower liquid flowrates, a minimum length was also necessary before entrainment could take place. The rate of interchange was studied by adding a fluorescein dyestuff to the liquid film; the fall off of concentration of this dyestuff with length could be used to measure the interchange rate. Author

N66-19510*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A MONTE CARLO PROGRAM FOR TRANSMISSION PROBABILITY CALCULATIONS INCLUDING MASS MOTIONS

James O. Ballance 1 Feb. 1966 49 p refs

(NASA-TM-X-53386) CFSTI: HC $2.00/MF $0.50 CSCL 20D

A Monte Carlo computer program which can be used to calculate the transmission probabilities for two cylindrical tubes in series is described, as well as the technique of adding directed mass motion to the random thermal motion of the molecules. The results for a simple straight cylindrical duct are compared to other solutions, and angle-of-attack effects are examined. Complex systems for which no adequate solutions have previously been found are easily analyzed by this method. The Fortran instructions are listed along with a typical program solution. Author

N66-19544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDRODYNAMIC RESISTANCE AND HEAT TRANSFER OF A HOUSED DISK WITH RADIAL FLOW IN THE GAP

N. I. Nikitenko 30 Nov. 1965 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 9, 1964 p 49–53
(FTD-TT-65-1136/1+4; AD-625187) CFSTI: HC $1.00/MF $0.50

Separate boundary layers are formed on the surfaces of a revolving disk and cylindrical housing for large Reynolds numbers and axial gaps. The thickness of the boundary layers formed on these surfaces are found with the aid of integral relationships obtained from the differential equations of the axisymmetric boundary layer. The profiles of the surrounding speeds in the case of laminar flow in the boundary layers of the disk and housing are determined. Also, the procedure for the computation of the hydrodynamic resistance of the disk is considered. The heat problem can also be considered using as a basis the solution of the hydrodynamic problem.

E.E.B.

N66-19554# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBULENT BOUNDARY LAYER OF A COMPRESSIBLE GAS
S. S. Kutateladze and A. I. Leont'yev 25 Oct. 1965 183 p refs Transl. into ENGLISH of the bood "Turbulentnyy Pogranichnyy Sloy Szhimayemogo Gaza" Novosibirsk, Izd. Sibirsk. Otd. Akad. Nauk. SSSR, 1962 p 1–180
(FTD-MT864-164; AD-625803) CFSTI: HC $5.00/MF $1.00

The theory of a turbulent boundary layer of a compressible gas is set forth or based on a study of the relative change of the coefficients of friction and heat transfer with growth of the M number, the heat transfer factor and the wall permeability factor b. The existence is shown of a limiting law, corresponding to very large Re numbers and almost full of self-simulation of relative changes of the coefficients of friction and heat transfer. Engineering methods are presented for solving the basic problems of friction and heat transfer in turbulent flow of a gas past a solid body. The theoretical conclusions are compared with experimental data. Author (TAB)

N66-19565# California Univ., Los Angeles. Dept. of Engineering.
A HYDRAULIC ANALOG STUDY OF THE HARTMANN OSCILLATOR PHENOMENON
Louis Solomon Oct. 1965 69 p refs
(Contract Nonr-233(621)
(Rept.-65-46; AD-625085) CFSTI: HC $3.00/MF $0.75

The paper describes the construction of a water channel and its use for the investigation of the hydraulic analog of the Hartmann oscillator problem. Continuous 'shooting' water flow was found to be analogous to supersonic isentropic gas flow; a static depth of approximately one quarter-inch of water appeared to be satisfactory with this channel. Measurements were of two types: direct measurement of the height of the free surface, and measurement obtained through photographic records. Quantitative agreement between hydraulic jumps and shock waves was not obtained; this was not expected due to the theory given in the text. Qualitative features of the flow were reproduced and agreed well with observations made with the cavity in the air stream. For research purposes, it seems that the most valuable aspect of the hydraulic analogy is its ability to easily present excellent flow visualization of flow phenomena which are not well understood. Furthermore, its usefullness as a teaching aid for the subject of fluid mechanics seems obvious. Author (TAB)

N66-19566# Colorado State Univ., Fort Collins. Engineering Research Center.
A THREE-DIMENSIONAL SINGLE ROUGHNESS ELEMENT IN A TURBULENT BOUNDARY LAYER
H. W. Tieleman and V. A. Sandborn [1965] 21 p refs
(Grant DA-AMC-28-043-64-G-9)
(AD-623902) CFSTI: HC $1.00/MF $0.50

An investigation of the influence of a single roughness element (sphere) in a turbulent boundary layer of a smooth flat plate is reported. The pressure distribution around the surface of the sphere was measured. Integration of the pressure distribution was used to compute the drag and lift forces on the element. Measurements of the mean and turbulent velocity distributions in the boundary-layer behind the sphere were made. Author

N66-19576# Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATION OF METHODS FOR RE-ESTABLISHMENT OF A LAMINAR BOUNDARY LAYER FROM TURBULENT FLOW Summary Report
W. Pfenninger and John W. Bacon, Jr. Feb. 1965 65 p refs
(Contract NOw-63-0762-c)
(NOR-65-48; AD-624488) CFSTI: HC $3.00/MF $0.75

By means of area suction, laminar flow was reestablished in tripped turbulent boundary layers for a unit Reynolds number range from 0.4 to 1.0 million per foot in incompressible flow. The removal of about 1.5 times the turbulent boundary layer thickness is adequate to restart a maintainable laminar boundary layer. Hot wire observations show that the restarted laminar boundary layer is generally a composite layer with laminar velocity fluctuations from the wall out to about one boundary layer thickness and weak turbulent velocity fluctuations in the outer portion. Author (TAB)

N66-19625# Iowa Inst. of Hydraulic Research, Iowa City.
CAVITATION AND ENERGY DISSIPATION IN CONDUIT EXPANSIONS
Hunter Rouse and Vladimir Jezdinsky (Czech. Acad. of Sci.) [1965] 14 p refs Presented at the Intern. Assoc. for Hydraulic Res. 11th Intern. Congr., Leningrad, 1965 *Its* Repr. No. 204
(Contract Nonr-1509(03)) CFSTI: HC $1.00/MF $0.50

A laboratory study is described of the onset and development of cavitation in the turbulent eddies produced by the diffusing stream at an abrupt pipe enlargement. Evaluations of incipient cavitation, pressure distribution, head loss, and incipient boundary damage are presented for use in the design of high-head relief conduits. Author

N66-19658*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
A STUDY OF PRESSURE PREDICTION METHODS FOR RADIAL FLOW IMPELLERS, PHASE III Quarterly Report No. 1
W. E. Young 1 Oct. 1965 20 p ref
(Contract NAS8-5442)
(NASA-CR-70749; PWA-FR-1563) CFSTI: HC $1.00/MF $0.50 CSCL 20D

This report covers progress in an investigation of pressure prediction methods for radial flow impellers. Tests were conducted and included smooth disk tests, with and without an inlet hub, in water and liquid hydrogen; a smooth disk reverse

flow test with hydrogen; and a high pressure (650 psia) liquid hydrogen smooth disk test. The data from these tests have been reduced and the results are discussed in this report.
Author

N66-19683# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PASSAGE OF AN UNBALANCED GAS THROUGH THE CRITICAL SECTION OF A NOZZLE
A. S. Pleshanov 8 Dec. 1965 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 1, 1964 p 74–77
(FTD-TT-65-1134/1+4; AD-625065) CFSTI: HC $1.00/MF $0.50

A solution is given in the first two approximations for the minor relaxation parameters the equations of hydrodynamics, taking into account the processes for stationary flows of an unbalanced gas in the region of the critical section of the nozzle and the states: (1) close to the balanced, (2) close to the completely unbalanced ('frozen'). Author (TAB)

N66-19725# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LAMINAR BOUNDARY LAYER IN A HIGH SPEED GAS FLOW
S. M. Kapustianskii [1965] 10 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 248, 1965 p 59–64

A method is proposed for computing the laminar boundary layer in a gas with an arbitrary external flow velocity which generalizes the parametric method of integrating the laminar boundary layer equations and is free of the disadvantages of the approximate method of Cohen and Reshotko. E.E.B.

N66-19774# California Univ., Berkeley. Dept. of Engineering.
FLUID MOTION AND SOUND Final Progress Report, 1 May 1959–31 Oct. 1965
Louis Solomon Nov. 1965 11 p refs
(Contract Nonr-233(62))
(Rept.-65-49; AD-625087) CFSTI: HC $1.00/MF $0.50

A bibliography is presented along with selected abstracts. Areas of study include: (1) vortex sound; (2) random pressure field effects on a flexibility support string; (3) hole tone experiments; (4) low speed edgetones; (5) hydraulic analogies of the Hartmann oscillator phenomenon; and (6) jet flows and edgetones. D.T.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-18517# Teledyne, Inc., Alexandria, Va. UED Earth Sciences Div.
SEISMIC DATA LABORATORY Semiannual Technical Summary Report No. 7, Oct. 1964–Mar. 1965
15 Apr. 1965 71 p refs
(Contract AF 33(657)-12447; ARPA Order 624; Proj. Vela Uniform)
(AD-625545) CFSTI: HC $3.00/MF $0.75

The purpose of the work has been to give a technical evaluation of the analysis of variance as a method of automatic signal detection. The analysis of variance has been programmed for the digital computer and the resulting program may be considered an array processor for the purpose of signal detection only. TAB

N66-18518# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW METHODS OF PLASMA DIAGNOSTICS ACCORDING TO SPECTROSCOPIC DATA
A. P. Kudrin and G. V. Sholin 19 Nov. 1965 17 p refs Transl. into ENGLISH from the Russian Presented at the VI Intern. Symp. on Ionization Phenomena in Gases, Paris, Jul. 1963
(FTD-MT-65-99; AD-625239) CFSTI: HC $1.00/MF $0.50

Measurements of charged particle concentrations in a dense plasma were performed by comparison of spectral line profiles with theoretical considerations. Asymmetric contour lines and line shifts of hydrogen and helium $_{II}$ at 4686 Å were explained as simple functions of density of the charged component of the plasma and used to establish plasma magnitude. Quasi-state approximations were utilized to formulate the influence of ions on the line form and to develop the interaction energy of the ion with an atom of hydrogen. For a detailed study of the line form it was necessary to calculate the intensities of the Stark components, taking into account quadrupole interaction of the sublevels. It was found that the shift of the line increased with density and depended weakly on the specific form of the distribution function for ions and their quantity. Theoretical values showed good agreement with experimental data. G.G.

N66-18523* RAND Corp., Santa Monica, Calif.
NUMERICAL ESTIMATES OF LUMINANCE AND TOTAL BRIGHTNESS OF THE TERRESTRIAL HALO
R. C. Moore and G. F. Schilling Nov. 1965 49 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4747-PR; AD-625233) CFSTI: HC $2.00/MF $0.50

An application of a semiempirical method to obtain quantitative values of the brightness of the earth's halo as it would appear to an observer in space experiencing a central total solar eclipse with the earth as the eclipsing body. Results are presented for a range of radial altitudes from 10,000 to 255,000 km. Both the luminance or surface brightness of the atmospheric halo and the total brightness or illumination received by an observer within this altitude range are given. Extensive appendixes fully discuss the mathematical treatment, including the implicit assumptions and estimates of the probable accuracy. Author (TAB)

N66-18532# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
ION FRACTIONATION IN DROPS FROM BREAKING BUBBLES
Ferren Mac Intyre (Ph.D. Thesis) Sep. 1965 275 p refs Sponsored by ONR
(AD-625179) CFSTI: HC $6.00/MF $1.50

Available data for ion ratios in precipitation are analyzed and shown to be consistent with the hypothesis of a

distinctive marine aerosol in which all reported ions are enriched with respect to Na, compared with sea water values. Experiments with bubble-produced aerosols from a $Na^{22}P^{32}O_4$ solution show that the fractionation ratio

$$\frac{(PO_4^{-3}/Na)\,\text{aerosol}}{(PO_4^{-3}/Na)\,\text{solution}}$$

is greater than 1 for all drop sizes from 0.5 to 50 microns, and may be as high as 700 for 15 micron drops. Drops formed by the central jets of small bubbles show enrichment ratios E(=F-1) below 10 which are independent of drop size, while drops from the film caps of large bubbles frequently show an additional high peak, log-normal and centered on micron drops, with a standard deviation (about the geometric mean) of log 1.75. It is suggested that small bubbles form an efficient surface microtome which selectively ejects only the uppermost 1-micron layer of the solution into the aerosol phase, and that this selectivity is responsible for the anomalous ion ratios reported in marine precipitation. Author (TAB)

N66-18546# Army Foreign Science and Technology Center, Washington, D. C.
ROLE OF ABSORBED RADIATION IN FORMING THE RADIATIVE BALANCE
T. G. Berlyand and V. V. Mukhenberg Dec. 1965 20 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 139, 1963 p 3–15
(FSTC-381-T65-563; AD-626065) CFSTI: HC $1.00/MF $0.50

The absorbed radiation distribution patterns on the surface of the earth are studied using data from observations and computations. The connections between the absorbed radiation and the radiative balance, and also between the absorbed radiation and the air temperature, are considered.
Author (TAB)

N66-18549# Geotechnical Corp., Garland, Tex.
ARRAY LITERATURE Bibliography, 1955–1965
9 Nov. 1965 52 p refs
(Contract AF 33(657)-12145)
(TR-65-114; AD-626405) CFSTI: HC $3.00/MF $0.50

A bibliography of available literature on array technology has been compiled, embracing the disciplines of seismology, acoustics, and radio. Over one hundred articles from various scientific journals are listed. Most of the articles are abstracted and are grouped according to a major category, Field of Application, and a subcategory, Character of Content. The majority of the articles were published during the period 1955–1956. Author (TAB)

N66-18587# RAND Corp., Santa Monica, Calif.
ON THE COLLISIONS OF VERY SMALL CLOUD DROPS
M. H. Davis Jan. 1966 13 p refs Presented at AMS Meeting, Reno, Nev., Oct. 1965 Submitted for Publication
(P-3268; AD-626606) CFSTI: HC $1.00/MF $0.50

Conclusions: Some of the hydrodynamic force expressions used by Hocking (The collision efficiency of small drops, Quart. J. Roy. Met. Soc., 85, 44–50 (1959)) are incorrect for close droplet separations. His conclusions should therefore be regarded with suspicion. Preliminary results based on an improved Stokesian hydrodynamic theory show no evidence for the 19-micron collision efficiency cut-off. The Stokes approximation is inadequate at Reynolds numbers as small as 0.25 for nearly equal spheres. Its range of validity in the two-sphere hydrodynamic problem should be investigated.
Author (TAB)

N66-18601# United Electrodynamics, Inc., Pasadena, Calif.
TONTO FOREST SEISMOLOGICAL OBSERVATORY Final Report, 17 Nov. 1961–30 Apr. 1965
P. S. Klasky, G. F. Francis, O. R. Russell, and H. W. Russell 25 Jun. 1965 236 p refs
(Contract AF 33(657)-7747; Proj. Vela Uniform)
(UED-371-1665-0026; AD-625464) CFSTI: HC $6.00/MF $1.25

The Tonto Forest Seismological Observatory (TFSO) is the largest and most versatile observatory operating under the VELA UNIFORM Program. The Arizona site was chosen for its low ambient noise characteristics. It has been determined that under optimum conditions there is a 90% probability of detecting a magnitude 3.5 earthquake at a distance of 75 degrees. The array configuration includes a complement of 46 vertical and 26 horizontal short-period J-M seismometers, three 3-component sets of long-period and intermediate-band seismometers, two sets of 3-component short-period Benioff and two Wood-Anderson seismometers. The array of seismometers and Observatory are located in a tree-covered area six miles square near Payson, Arizona, on U.S. National Forest land. Phototube amplifiers are used for amplification and are supplemented by low impedance output isolation amplifiers which allow complete versatility of operation with any number of recorders for either routine or experimental programs. The TFSO also contains facilities for seismic system development and evaluation such as a complete machine shop, vertical shake table, large engineering laboratory for use of visiting VELA contractors, a large underground vault, area 1100 square feet, for experimental work.
TAB

N66-18610# National Observatory of Athens (Greece). Ionospheric Inst.
STUDIES OF THE IONOSPHERE USING TRANSMISSIONS FROM ACTIVE SATELLITES Annual Report, 1 Jan. 1964–28 Feb. 1965
Michael Anastassiadis [1965] 26 p refs
(Contract AF 61(052)-754)
(AFCRL-65-626; AD-626199) CFSTI: HC $2.00/MF $0.50

During the past year and the above considered period, Athens center, recorded a large number of transmissions from active satellite, in order to investigate the ionosphere. Amplitude recordings were obtained following a common program established for JSSG Laboratories. Results from others special programs prepared by Athens center, in order to investigate definite problems of the upper atmosphere, are also reported.
Author (TAB)

N66-18619# Army Foreign Science and Technology Center, Washington, D. C.
TWO TYPES OF IONOSPHERIC STORMS
A. S. Besprozvannaya Dec. 1965 19 p refs Transl. into ENGLISH from Problemy Arktiki i Antarktiki (Leningrad), no. 13, 1963 p 67–78
(FSTC-381-T65-550; AD-626071) CFSTI: HC $1.00/MF $0.50

Phenomena observed in the ionosphere at the time of magnetic disturbances are discussed. On the basis of the material on ionospheric observations collected over a period of ten years (1946–1955) in the Tiksi bay, located near the zone of maximum auroral frequency, it is demonstrated that the relationship between the disturbances in the upper layers of the ionosphere (lowering of f_0 F2), and those in the lower layers (anomalous absorption) vary substantially from storm to storm. It was possible to isolate two types of storms: F-type

storms, for which no noticeable increase of anomalous absorption is observed in the auroral zone in the presence of strong disturbances in the F2 layer and the FD-type storms, in which a substantial increase of anomalous absorption was observed simultaneously with a decrease in f_0 F2. TAB

N66-18629# Ionospharen-Institut Breisach (West Germany).
CRITICAL DISCUSSION OF SOME E REGION DRIFT DATA Annual Summary Report, 1964–1965
E. Harnischmacher 15 Jul. 1965 21 p
(Contract AF 61(052)-672)
(IIB-13a; AFCRL-65-821; AD-626194) CFSTI: HC $1.00/MF $0.50

Detailed investigation of reductions published in IIB No. 13 (AD-614670) indicates that some confusion exists concerning the relation of the recorded traces with the antennae. A special test method is described. Author (TAB)

N66-18633# Johns Hopkins Univ., Baltimore, Md. Lab. of Astrophysics and Physical Meteorology.
MOISTURE CONTAMINATION AT ALTITUDE BY BALLOON AND ASSOCIATED EQUIPMENT
R. Zander 1965 13 p refs
(AD-624711) CFSTI: HC $1.00/MF $0.50

Spectra of the 6.3 micron water band were recorded by a ballon-borne spectrometer at 23.5 km altitude and over a wide range of sun elevations. Reduced in terms of transmittance they show an unexpected increase in humidity with increasing solar elevation angle. This feature is interpreted as a contamination by moisture carried at altitude by the package, the balloon, and associated train. An analysis based on this interpretation gives 0.0000105 as the corrected stratospheric mixing ratio above 23.5 km. Author (TAB)

N66-18649*# HRB-Singer, Inc., State College, Pa.
PRE-SUNRISE CHANGES IN VLF RADIO WAVES IONOSPHERICALLY REFLECTED NEAR VERTICAL INCIDENCE-II Final Report
J. M. Musser Jan. 1966 33 p refs *Its* Rept.-770-R-2
(Contract NASw-1109)
(NASA-CR-70820) CFSTI: HC $2.00/MF $0.50 CSCL 04A

This report describes the results of a continued program of measurement of the down-coming skywave of Navy VLF station NSS as received at Wallops Island, Virginia. These measurements, in cooperation with the University of Illinois and its D-region rocket experiments, have detected the development of the C-region of the ionosphere before ground sunrise. Author

N66-18651# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF THE EFFECTS OF GRAVITY ON CRATER FORMATION IN A COHESIONLESS MEDIUM
Leon Karol Moraski and David Jens Teal (M.S. Thesis) Jul. 1965 190 p refs
(MECH/GSF-65-35; AD-625391) CFSTI: HC $5.00/MF $1.00

An experimental investigation was conducted on the effects of gravity on explosion crater formation. Accompanying the presentation of the experimental results is a discussion of gravity effects on the cratering processes of compaction, scouring, spalling, and gas acceleration. The discussion suggests that gravity influences the shear resistance of the medium and the range of the particle throwout and hence should influence the crater formation. To test this hypothesis, an experiment was conducted in a medium of dry silica sand using a six grain electrically initiated squib as the explosive source. Craters were formed under 0.17 g, 0.38 g, 1.0 g, and 2.5 g conditions and at depths of burst ranging from surface to five inches. The statistical t-test was used to determine if the crater depth and diameter were affected by the gravity field. Crater dimensions versus depth of burst (DOB) were compared for the different gravity fields to study the effect on the optimum and maximum DOB. An equation expressing crater dimensions as a decreasing exponential function of increasing gravity was assumed. Parameters of the exponential function were adjusted to achieve the best fit in the least-squares sense.
Author (TAB)

N66-18657# Texas Instruments, Inc., Dallas. Science Services Div.
MULTIPLE ARRAY PROCESSOR Quarterly Report, 1 Jan.–31 Mar. 1965
25 Apr. 1965 4 p
(Contract AF 33(657)-13904; ARPA Order 104)
(QR-2; AD-625491) CFSTI: HC $1.00/MF $0.50

Three multichannel filter (MCF) systems for separating teleseismic signals from ambient noise were built and evaluated. Two systems designed, respectively, for infinite velocity signals, and signals with horizontal propagation velocities between 8.1 km/sec and infinite velocity, proved satisfactory. Also, an MCF test set containing one delay line and two multichannel outputs has been constructed and tested; good results were obtained for analog measurements. D.T.

N66-18740# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY, JULY–DECEMBER 1963
Apr. 1964 204 p refs
(BIO/04/64)

Data are presented on the gross β radioactivity due to fallout fission products in samples of air, rain water, and surface waters; the content of ^{90}Sr, ^{89}Sr, and ^{137}Cs in samples of milk and other foods collected at 16 sites located throughout Italy from July through Dec. 1963. NSA

N66-18914# Atomic Energy Commission Research Establishment, Riso (Denmark). Reactor Physics Dept.
ON THE THEORY OF THE NEUTRONIC METHOD FOR MEASURING THE WATER CONTENT IN SOIL
P. L. Olgaard Jan. 1965 45 p refs
(RISO-97)

Investigations on the theoretical treatment of the neutronic method for measuring the water content in subsurface soil are reported. By comparison with experimental data for the thermal flux distribution around a fast neutron point source in pure water a three-group diffusion-theory model was selected as the the basis of the investigations. The geometry considered for the soil moisture probe is a fast neutron point source in an infinite, homogeneous medium and a line detector with its center at the source. The formulas used are derived, the methods applied for determining the necessary nuclear constants of the soil are described, and tables of cross sections are given. Up to 20 elements are involved in the determination of the nuclear constants. Numerical calculations for typical Danish soil types for which

experimental investigations have been performed and chemical analyses are available, were carried out by means of an ALGOL computer program. The results were compared with experimental results, and excellent agreement was found. The effect of variation of a number of parameters was studied. Changes of the density, the absorption cross section, and the content of hydrogen in the dry soil were found to be important for the count-rate obtained. Objections are raised to the concept of the sphere of influence, and instead a new concept, the sphere of importance, which is consistent with theory and experimental data, is introduced. A print-out of the ALGOL program is appended. Author (NSA)

N66-18944# Hollandse Metallurgische Industrie Billiton N. V., Arnhem (Netherlands).

A STUDY OF SOME NIOBIUM-BEARING MINERALS OF THE LUESHE CARBONATITE DEPOSIT (KIVU, REPUBLIC OF CONGO)

L. Van Wambeke Brussels, EURATOM, 1965 31 p refs Presented at Symp. on the Mineralology of Carbonatite and Alkaline Ultrabasic Rocks, New Delhi, Dec. 1964 (EUR-2110.e; CONF-641212-1)

New data are given on the mineralogy and on the geochemistry of some niobium-bearing minerals from the Lueshe carbonatite deposit: pyrochlore, hydrated K-Sr pyrochlore, fersmite, columbite, lueshite, aegirite, zircon, and a probably new iron titanium mineral of formula $(Fe^{II},Mn,Mg)_4Fe_2^{III}Ti_6O_{19}$. In the three last minerals, Nb and Ta occur as accessory elements. Ba-goyazite was also found as mineral inclusions in some pyrochlores. The new hydrated K-Sr pyrochlore shows a large deficit of the elements in the A-positions and a parameter value of about 10.58 Å. Its origin is discussed. Two types of fersmites (I and II) were found: the first is associated with the columbitization of pyrochlore, the second replaces columbite and occurs in a later carbonatitic stage. Physical properties, X-ray data, and a chemical analysis are given for the probably new iron titanium mineral. The geochemical distribution of Nb, Ta, rare earths, U, Th, and other elements was studied in all minerals investigated. The Nb–Ta ratio widely varies and is much higher in the niobium minerals whereas the lowest values were found in the Nb-containing minerals. The Ce group dominates in the pyrochlores and in lueshite and the Y group in the fersmite II and in the zircon. The Ca-niobates are generally richer in U whereas Th is predominant in zircon and especially in lueshite. The processes of the columbitization of pyrochlore and the fersmitization of columbite are described. From these processes it is indicated that the carbonatitic differentiation is characterized in a late stage by an enrichment with Ta, Fe, Mn, V, and rare earths. Author (NSA)

N66-18972# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE BOTTOM 300-METER LAYER OF THE ATMOSPHERE

N. L. Byzova, ed. 1965 126 p refs Transl. into ENGLISH of the book "Issledovanie Nizhnego 300-Metrovogo Sloya Atmosfery" Moscow, Izd. Akad. Nauk SSSR, 1963 Published for Dept. of Commerce and NSF (TT-65-50010) CFSTI: HC $4.00/MF $1.00

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13. METHODS OF MEASUREMENT OF THE ION SPECTRUM ON THE UPPER-AIR MAST N. M. Ivanova, G. M. Kuklina, and Yu. Sedunov p 101–112 refs (See N66-18985 09-13)

N66-18973 Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTS ON THE SPREADING OF PRECIPITATING ADMIXTURE FROM A POINT SOURCE IN THE BOTTOM LAYER OF THE ATMOSPHERE [OPVTY PO RASPROSTRANENIYU OSAZHDAYUSHCHEISYA PRIMESI OT TOCHECHNOGO ISTOCHNIKA V NIZHNEM SLOE ATMOSFERY]

A. K. Aleksandrova, N. L. Byzova, and G. B. Mashkova *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 1–12 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Measurements of the precipitation density involving the spreading of an admixture from a point source were compared with values calculated by a model atmosphere where the coefficient of vertical turbulent diffusion increased with height, and from a model where the coefficient was independent of the vertical coordinate. Atmospheric stratification was found to be proportional to the height of the source within ±25%. Parameters of peak precipitation density, position of the

peak, and precipitation density trails were determined by the dimensional quantity which denoted the ratio between the gravitational and the turbulent forces. An empirical formula was formed for calculating a rough estimate of maximum precipitation density. G.G.

N66-18974 Israel Program for Scientific Translations, Ltd., Jerusalem.
THE WIND PROFILES AND THE TURBULENCE CHARACTERISTICS IN THE BOTTOM 300-METER LAYER OF THE ATMOSPHERE [O PROFILYAKH VETRA I KHARAKTERISTIKAKH TURBULENTNOGO REZHIMA V NIZHEM 300-METROVOM SLOE ATMOSFERY]
Z. I. Volkovitskaya and G. B. Mashkova *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 13–25 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Wind velocity and temperature profiles in the bottom 300-meter layer of the atmosphere were analyzed from data obtained by a 300 m high meteorological mast during August through September 1961. Measurements were made with telemeteorographs. Data of serial observations showed that under nearly indifferent stratification conditions, as well as in cases of moderate stability and instability, the wind and temperature profiles were similar for all wind directions in which measurements were taken. Analyses of wind profiles over the height of the mast showed intensified wind instabilities toward midday, turning into straight lines toward evening when nearly isothermal conditions arose. G.G.

N66-18975 Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME MEASUREMENT FINDINGS ON THE HORIZONTAL DIFFUSION OF ADMIXTURE IN THE BOTTOM ATMOSPHERIC LAYER [NEKOTORYE REZUL'TATY IZMERENII GORIZONTAL'NOI DIFFUZII PRIMESI V NIZHNEM SLOE ATMOSFERY]
N. L. Byzova *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 26–35 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Data on the spreading of precipitation admixtures were analyzed for their horizontal aerosol diffusion in the atmospheric bottom layer. Precipitation density distributions on the ground surface were utilized to calculate cross-sectional dispersion, and examples of the experimental distribution values were depicted in tables. According to results, dispersion in the distribution trail corresponded to dispersion in the stream of admixture from a continuously active source obtained by averaging the measured values of the concentration of the stream over a period of time. The width of the dispersion stream varied insignificantly even up to heights of several tens of kilometers. G.G.

N66-18976 Israel Program for Scientific Translations, Ltd., Jerusalem.
STATISTICAL CHARACTERISTICS OF TURBULENT DIFFUSION AND THEIR ESTIMATION IN THE BOTTOM LAYER OF THE ATMOSPHERE [STATISTICHESKIE KHARAKTERISTIKI TURBULENTNOI DIFFUZII I IKH OTSENKA V NIZHNEM SLOE ATMOSFERY]
V. N. Ivanov *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 36–42 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

The characteristics of Lagrangian turbulence in the bottom atmospheric layer were studied through development of diffusion models. Considered were diffusion variations with height, quantity of the turbulence, and the distance over which the diffusion cloud drifted along the flow. Estimates were formed for the statistical turbulent moments which describe the motion of a single point. G.G.

N66-18977 Israel Program for Scientific Translations, Ltd., Jerusalem.
ATMOSPHERIC STRATIFICATION CHARACTERISTICS IN INVERSIONS [O KHARAKTERISTIKAKH STRATIFIKATSII ATMOSFERY PRI INVERSIYAKH]
G. B. Mashkova *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 43–47 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Analyses of daily variations in observed air-temperature profiles showed that under conditions of inversion, the same values for the magnitude and depth of the inversion as produced by the emission of radiation may result for different structures of the investigated layer. Position and thickness of the inversion layers and of the inversion magnitude should be included in the analysis of the whole stratified layer structure. G.G.

N66-18978 Israel Program for Scientific Translations, Ltd., Jerusalem.
INVESTIGATION OF ATMOSPHERIC TURBULENCE BY MEANS OF THE M-27 BRIDLED-CUP ANEMOMETER [ISSLEDOVANIE ATMOSFERNOI TURBULENTNOSTI S POMOSHCHYU ZATORMOZHENNOGO ANEMOMETRA M-27]
V. N. Ivanov *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 48–56 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Experimental data on atmospheric turbulences as obtained from bridled-cup anemometers installed on an upper meteorological mast, were analyzed. Wind gauge signals were recorded by potentiometer and processed on an electro-mechanical correlometer for computations of correlation functions and dispersions. Turbulence intensity profiles obtained showed a definite variation of turbulent intensity with height. Its value in the 50–150 m layer was higher than 1 m^2/sec^2, and at a height of 200 to 300 it dropped to 0.1 to 0.3 m^2/sec^2. It was concluded that the bridled-cup anemometer is suitable for systematic turbulent wind measurements. G.G.

N66-18979 Israel Program for Scientific Translations, Ltd., Jerusalem.
THE MEASUREMENT OF THE WIND VELOCITY IN THE BOTTOM 300-METER ATMOSPHERIC LAYER ON AN UPPER-AIR METEOROLOGICAL MAST [OB IZMERENII SKOROSTI VETRA V NIZHNEM 300-METROVOM SLOE ATMOSFERY NA VYSOTNOI METEOROLOGICHESKOI MACHTE]
F. Ya. Klinov and V. V. Poltavskii *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 57–63 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Mean wind velocity data in the bottom 300 m atmospheric layer were obtained from photoelectronic anemographs fastened to an upper air meteorological mast. Wind velocity data were evaluated on the basis of the following criteria: (1) a smooth variation of the wind velocity profile drawn over the measurement points with allowance for error; (2) conformation of the profile curve by the tendency of subsequent wind

velocity profiles; (3) agreement of the obtained profile with the standard profile; and (4) the possibility of matching wind velocity variations with corresponding behavior of other meteorological parameters. Various wind profiles are shown in tables. G.G.

N66-18980 Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONSIDERATION OF THE ACCURACY OF WIND-VELOCITY MEASUREMENTS ON THE PHOTOELECTRIC ANEMOGRAPH OF THE UPPER-AIR MAST [K VOPROSU O TOCHNOSTI IZMERENIYA SKOROSTI VETRA FOTOELEKTRONNYM ANEMOGRAFOM VYSOTNOI MACHTY]

Yu. A. Kurpakov and B. Ya. Tolstobrov *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 64–68 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Wind velocity measurements obtained by a photoelectronic anemograph fastened on the upper-layer (300 m) meteorological observation mast were compared against values from a standard contact anemograph. Test data evaluation showed that the photoelectronic anemograph provided a measurement accuracy to within ±0.5 m/sec+3% of the measured velocity up to 3 m/sec. G.G.

N66-18981 Israel Program for Scientific Translations, Ltd., Jerusalem.

MEASUREMENT OF THE TEMPERATURE IN THE BOTTOM 300-METER ATMOSPHERIC LAYER ON THE UPPER-AIR MAST [OB IZMERENII TEMPERATURY V NIZHNEM 300-METROVOM SLOE ATMOSPHERY NA VYSOTNOI MACHTE]

F. Ya. Klinov and V. D. Andreev *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 69–76 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Described and evaluated is a thermogradientograph used to measure the temperature and lapse rate in the bottom 300 m atmospheric layer. This instrument consists of temperature gauges with resistance arms for measuring bridges, a relay multiway switch, and an intermittent-contact recorder. Temperatures and temperature differences are measured by a zero-point measuring method utilizing a bridge balancing condition. An example recording of temperature variations during a thunderstorm is presented that shows a sharp drop in temperature throughout the layer by 6° to 7°C at the time of electrical discharge and rain. G.G.

N66-18982 Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONSIDERATION OF THE ACCURACY OF THE UPPER-AIR MAST THERMOGRADIENTOGRAPH [K VOPROSU O TOCHNOSTI TERMOGRADIENTOGRAFA VYSOTNOI MACHTY]

P. M. Mushenko *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 77–82 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Accuracy of the automatic remote thermogradientograph mounted on an upper-air mast was analyzed by plotting the root-mean-square error of any series of resistance-coil temperature measurements against the number of readouts. Starting from about 40 to 50 readouts, the root-mean-square error was practically unaffected by any increase in the number of readouts and remained equal to 0.07°. The resultant arithmetic mean error of the standard instrument was n=50. G.G.

N66-18983 Israel Program for Scientific Translations, Ltd., Jerusalem.

ESTIMATION OF THE EFFECT OF THE 300-METER METEOROLOGICAL MAST STRUCTURE ON THE WIND-GAUGE READINGS [OTSENKA VLIYANIYA KONSTRUKTSII 300-METROVOI METEOROLOGICHESKOI MACHTY NA POKAZANIYA DATCHIKOV SKOROSTI VETRA]

E. V. Borovenko, O. A. Volkovitskii, L. M. Zolotarev, and S. A. Isaeva *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 83–92 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Effects produced by the cylindrical body of a meteorological mast and its riggings on the wind gauge readings of air flow currents flowing past the velocity gauges, were analyzed. The largest disturbances were created by the cylindrical body of the mast; readings at distances at which the wind gauges are usually installed showed variations of ±3% for various angles. No appreciable disturbance effects could be detected from the cylindrical spars, the balconies, and other structures. G.G.

N66-18984 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EXPERIMENTAL DETERMINATION OF STATISTICAL MOMENTS [OB EKSPERIMENTAL'NOM OPREDELENII STATISTICHESKIKH MOMENTOV]

V. N. Ivanov and A. G. Popova *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 93–100 (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

A method for the determination of statistical moments as quantitative characteristics for turbulent atmospheric fields is presented that utilizes calculations of the values situated near the center of the gravity of the distribution. Also considered is a numerical characteristic of the distribution law which increases or decreases the "specific weight" of any given portion of the distribution in the magnitude of the moment. Example calculations are shown. G.G.

N66-18985 Israel Program for Scientific Translations, Ltd., Jerusalem.

METHODS OF MEASUREMENT OF THE ION SPECTRUM ON THE UPPER-AIR MAST [METODIKA IZMERENII IONNOGO SPEKTRA S VYSOTNOI MACHTY]

N. M. Ivanova, G. M. Kuklina, and Yu. Sedunov *In its* Invest. of the Bottom 300-Meter Layer of the Atmosphere 1965 p 101–112 refs (See N66-18972 09-13) CFSTI: HC $4.00/MF $1.00

Calculations have been carried out of the distortions in the electric field of the atmosphere and in the ion spectrum in the vicinity of the conducting mast and the results used as a basis for a method of measurement of the concentration and the spectrum of ions from the mast. Near the surface of the mast the field strength increases considerably and the direction of the field changes: it is directed horizontally, and the vertical component of the field may be neglected up to a distance of 50 m from the mast. Considerable changes are produced also in the ion spectrum. When the wind velocity increases, the size of the "dead" area is reduced. In the measurement of the flux density and the spectrum of the ions it is necessary to take into account the presence of the "dead" area when taking samples in the direction of advance of the air flow (on the windward side). With increasing distance from the mast the flux concentrations of the positive and negative ions tend to equalize. The calculations and preliminary measurements performed may be used in the measurement of atmospheric-electrical parameters on the upper-air mast. Author

N66-19007# National Physical Lab., New Delhi (India). Radio Propagation Unit.

DAILY RESPONSE OF THE IONOSPHERIC F-REGION TO CHANGES IN THERMOSPHERIC TEMPERATURE Scientific Report No. 24

S. Chandra and S. Rangaswamy 30 Oct. 1965 29 p refs Submitted for Publication

(RPU-S24) CFSTI: HC $2.00/MF $0.50

The effect of thermospheric heating on the F-region ionization is studied on a daily basis. It is found that at Puerto Rico, during the morning hours, electron density at fixed heights and maximum electron density, in general, follow the same variation as the temperature derived from satellite drag data. The same is true for the height of the maximum and the subpeak electron content just after sunrise. It is suggested that if EUV flux is assumed to be the main cause of thermospheric heating, the relationship between electron density and temperature just after sunrise can be explained due to changes in photoionization rate, caused by EUV flux. Later in the day, when a quasi-equilibrium condition is reached, the production-transport theory of the formation of the F_2-peak appears to be in accord with the observational data. Author

N66-19013# Joint Publications Research Service, Washington, D. C.

WORKS OF THE SECOND ALL-UNION CONFERENCE ON GEOGRAPHIC ASPECTS OF ILLUMINATION

N. M. Gusev, ed. 16 Feb. 1966 128 p refs Transl. into ENGLISH of the book "Trudy II Vsesoyuznoy Konferentsii po Svetovomu Klimatu" Moscow, 1961 p 1-96

(JPRS-34151; TT-66-30593) CFSTI: $4.00

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N66-19015 Joint Publications Research Service, Washington, D. C.

APPARATUS FOR MEASUREMENTS OF THE SPECTRAL COMPOSITION OF RADIATION

K. Ya. Kondrat'yev, Z. F. Mironova, I. Ya. Badinov, and M. P. Burgdva *In its* Works of the 2d All-Union Conf. on Geographic Aspects of Illumination 16 Feb. 1966 p 20-33 refs (See N66-19013 09-13) CFSTI: $4.00

A spectral instrument for investigating the spectral composition of total and scattered radiation, spectral brightness of direct solar radiation, transparency of the entire thickness of the atmosphere, and the spectral albedo is described. Also included is a brief summary of basic information concerning the spectral composition of the radiation reaching the Earth's surface. M.R.W.

N66-19016 Joint Publications Research Service, Washington, D. C.

THE DURATION OF SUNLIGHT AS AN INDEX OF ILLUMINATION AND INSOLATION, AND A METHODOLOGY FOR PROCESSING IT (USING WESTERN SIBERIA AS AN EXAMPLE)

L. I. Koldomasov *In its* Works of the 2d All-Union Conf. on Geographic Aspects of Illumination 16 Feb. 1966 p 34-47 (See N66-19013 09-13) CFSTI: $4.00

A method is presented for calculating the diurnal fluctuation of the duration and intensity of sunlight for various hours of the day. Such data are of considerable interest in the solution of problems associated with the illumination and orientation of buildings. As an example, meteorological data for these calculations were obtained from stations located in Western Siberia. M.R.W.

N66-19017 Joint Publications Research Service, Washington, D. C.

THE RADIATION BALANCE OF SLOPING SURFACES

K. Ya. Kondrat'yev and M. P. Manolova *In its* Works of the 2d All-Union Conf. on Geographic Aspects of Illumination 16 Feb. 1966 p 48-64 refs (See N66-19013 09-13) CFSTI: $4.00

Formulas, expressions, and relationships for determining the fluxes of scattered and reflected radiation on different slopes are presented. The results of calculations of the diurnal fluctuation and diurnal sums of the total and scattered radiation are summarized. Measurement of the relative magnitude of the radiation balance is reported. The problem of radiation balance of non-horizontal flat surfaces has extensive practical applications in construction, lighting engineering (using natural sunlight to the maximum possible degree), microclimatology, and agrophysics. M.R.W.

N66-19018 Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE BRIGHTNESS OF A CLOUDLESS SKY

Ye. V. Pyaskovskaya-Fesenkova *In its* Works of the 2d All-Union Conf. on Geographic Aspects of Illumination 16 Feb. 1966 p 103-111 (See N66-19013 09-13) CFSTI: $4.00

The problem of determining the distribution of brightness throughout the daytime sky in various localities, with an accuracy that is entirely adequate for practical purposes, is investigated. Calculations for the solution to this problem are based

on the determination of the residual brightness $B(\vartheta)/\psi(\vartheta)=\phi(z,\zeta,\rho)$, for various zenith distances of the almucantarats and the Sun and at various transparency factors of the atmosphere, in one locality, or, for better control, in two localities. If a precise knowledge of the brightness of the sky is necessary, in each locality it is necessary to determine the scattering function from observations of the brightness along the almucantarat of the Sun. M.R.W.

N66-19029# Texas Instruments, Inc., Dallas. Science Services Div.

ARRAY RESEARCH: THEORETICAL CAPABILITY OF SYSTEMS OF HORIZONTAL SEISMOMETERS FOR PREDICTING A VERTICAL COMPONENT IN AMBIENT TRAPPED-MODE NOISE Special Report

Thomas F. Potter and Robert B. Roden 9 Nov. 1965 79 p refs

(Contract AF 33(657)-12747; ARPA Order 104260) (SR-7; AD-626407)

From the results of the theoretical investigations reported in this report, it is concluded that multicomponent seismometer arrays offer a great deal of promise for signal enhancement applications. It is recommended that experimental investigations of such systems be undertaken as soon as possible. TAB

N66-19089*# Geophysics Corp. of America, Bedford, Mass.

STUDY OF WINDS, DIFFUSION, AND EXPANSION OF GASES IN THE UPPER ATMOSPHERE Final Report

May 1963 79 p

(Contract NASw-396)

(NASA-CR-70506; GCA-TR-63-16-N) CFSTI: HC $3.00/MF $0.75 CSCL 04A

During this period a major effort was directed toward rocket-borne vapor trail wind measurements and the correlation with simultaneous measurements using other techniques. These other methods included rocket grenades, Langmuir probe, pitot tube, and continuous wave propagation studies. Thirteen vapor trail rockets were launched from Wallops Island and wind data were obtained from eleven of these. Second stage failure of Nike-Asps occurred during two flights. Wind data from all flights were reduced and are included in this report. Some analysis of the total available wind data was also done. The wind data analysis involved efforts to determine seasonal diurnal effects, and correlation with other phenomena such as solar activity, E-layer variations, and wind measurements by other methods. A summary of some of the results is included. R.N.A.

N66-19093*# Hawaii Inst. of Geophysics, Honolulu.

F-REGION NIGHTGLOW EMISSIONS OF ATOMIC OXYGEN. II: ANALYSIS OF 6300 ANGSTROM AND ELECTRON DENSITY DATA

Vern L. Peterson (Environ. Sci. Serv. Admin.) and Walter A. Steiger [1965] 33 p refs *Its* Contrib. No. 127

(Grant NsG-135-61)

(NASA-CR-70853) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Nightglow 6300 Å and electron density data from Maui, Hawaii have been analyzed by using the formulas of Paper I. The observed 6300 Å emission is found to consist of two components. The primary component may vary considerably during the night and its variations are explained satisfactorily by the chemical reactions discussed in Paper I; these variations correspond to variations in the height, shape, and magnitude of the electron density profile. The secondary, or background, component does not seem to vary rapidly during the night but may vary considerably from one night to another. The source of the background component is unknown. It is shown that the magnitude deduced for it is insensitive to errors in the many parameters that enter the calculations. Finally, even though the theory given in Paper I does satisfactorily explain the observations, the pertinent chemical reactions seem to be inefficient in producing the 6300 Å nightglow. Author

N66-19130# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

CONCERNING THE THEORY ON THE DETERMINATION OF THE EARTH'S FIGURE AND DIMENSIONS BY SATELLITE OBSERVATIONS [K TEORII OPREDELENIYA FIGURY I RAZMEROV ZEMLI PO NOBLYUDENIYAM ISKUSSTRENNYKH SPUTNIKOV]

A. A. Izotov [1965] 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), Issue No. 3, 1965 p 3–11

(TC-962; AD-625884) CFSTI: HC $1.00/MF $0.50

The problem of a world system of geodetic coordinates referenced to the center of mass and to the principle axes of inertia of the earth is shown to be closely connected with the problem of determining the dimensions of the elementary terrestrial ellipsoid. Also, it is observed that this theorem of classical geodesy holds true when the observational results of the earth's artificial satellites are used in geodesy. E.E.B.

N66-19156# Centre National de Recherches de l'Espace, Brussels (Belgium).

DENSITY OF THE HETEROSPHERE RELATED TO TEMPERATURE

Marcel Nicolet Cambridge, Mass., Smithsonian Astrophys. Obs., Oct. 1961 34 p refs *Its* Notes Preliminaires No. 22 (SAO Special Rept.-75) CFSTI: HC $2.00/MF $0.50

Atmospheric models based on diffusion equilibrium in which helium plays a role are derived by use of heat conduction as the essential process that determines gradient of temperature. Introduction of boundary conditions at 120 km, where diffusion begins for major constituents, leads to atmospheric models that can be used for analysis of variations of day-to-night and solar activity in the whole thermosphere from 150 km to 2000 km. Physical parameters such as density, pressure, concentration, mean molecular mass and local scale-height are given as functions of the temperature, which is considered the fundamental parameter. Author

N66-19157# Centre National de Recherches de l'Espace, Brussels (Belgium).

THE COMPOSITION AND STRUCTURE OF THE TERRESTRIAL ATMOSPHERE

Marcel Nicolet May 1963 67 p refs Presented at the Air Force and Gen. Elec. Symp. on Dyn. of Manned Lifting Planetary Entry, Philadelphia, 29–31 Oct. 1962 Submitted for Publication *Its* Notes Preliminaires No. 28

CFSTI: HC $3.00/MF $0.75

After a general description of the various regions of the terrestrial atmosphere, an analysis of physical conditions leading to the knowledge of the heterosphere is given. Molecular dissociation and diffusion in the lower thermosphere are introduced to determine the concentration of various constituents

(N_2, O_2, O, N, He, H). Ultraviolet heating and conduction are considered as essential processes of production and loss of heat in the thermosphere. Finally, the ionospheric diffusion equilibrium is studied after considering the system of ionic reactions occurring in the ionosphere. Author

N66-19158# Centre National de Recherches de l'Espace, Brussels (Belgium).
THE IONOSPHERIC CONDITIONS
Marcel Nicolet and William Swider, Jr. Aug. 1963 25 p refs *Its* Notes Preliminaires No. 32
CFSTI: HC $3.00/MF $0.50

A general analysis of ionospheric conditions was made in the light of possible ionic reactions occurring in the upper atmosphere. Data obtained on various parameters such as ionic production and recombination, show that precise knowledge of the spectral distribution of solar radiation is needed and that other experimental determinations on dissociative recombinations are required. The ionic complexity of the ionosphere is underlined by describing how the atomic ions O^+ and N^+ react with N_2, O_2, and NO molecules. The behavior of the molecular ions N_{2+}, O_{2+}, and NO^+ depends on a group of simultaneous processes involving charge transfers and ion–atom interchanges which are more important than dissociative recombinations. The altitude distribution of ions is exemplified by discussing the relative importance of various loss coefficients in the D-, E- and F-regions. It is seen that molecular nitrogen ions are subject to important charge transfer processes, that nitric oxide ions are always final products destroyed only by dissociative recombination. Additionally, the entire production of atomic oxygen ions is related to the photoionization of molecular nitrogen. Some information is also given on possible anomalies in the ratio of O_{2+} and NO^+ densities in the lower ionosphere. Author

N66-19159# Centre National de Recherches de l'Espace, Brussels (Belgium).
THE EFFECT OF THERMAL DIFFUSION ON THE VERTICAL DISTRIBUTION OF HELIUM IN THE HETEROSPHERE [L'EFFET DE LA DIFFUSION THERMIQUE SUR LA DISTRIBUTION DE L'HELIUM DANS L'HETEROSPHERE]
G. Kockarts (Inst. Roy. Meteorol. de Belg.) Nov. 1963 22 p refs In FRENCH; ENGLISH summary Presented at the Roy. Acad. of Sci., 9 Nov. 1963 Submitted for Publication *Its* Notes Preliminaires No. 34
CFSTI: HC $1.00/MF $0.50

The effect of thermal diffusion on the vertical distribution of helium in the heterosphere is discussed. It is shown that an increase in the helium concentration of 1.4 to 2.4 at the thermopause level, due to thermal diffusion, leads to atmospheric densities explaining the observed drag of the satellite Echo I. Author

N66-19162# Centre National de Recherches de l'Espace, Brussels (Belgium).
THE STRUCTURE OF THE HETEROSPHERE [LA STRUCTURE DE L'HETEROSPHERE TERRESTRE]
M. Nicolet Dec. 1963 23 p ref In FRENCH; ENGLISH summary Presented at the XIV Congr. of the Astronautical Intern. Federation, Paris, Sep. 1963 *Its* Notes Preliminaires No. 37
CFSTI: HC $1.00/MF $0.50

Analysis of the observational data obtained by means of rockets and satellites gives rise to a new aspect of the problem of the heterosphere. The thermal balance sheet must take into account the heating effect on the thermosphere of the solar UV radiation, which varies over an eleven-year cycle of activity, and the cooling effect essentially associated with the transfer of heat by conduction. Photo-dissociation of molecular oxygen constitutes the main source of oxygen atoms. Diffusion of the gases in the gravitational field maintains the molecular constituents above the normal limits corresponding to the dissociation equilibrium. Normal diffusion accounts for the predominance of atomic oxygen in the upper thermosphere. In conclusion, the author emphasizes that, in the end, the elements which are the least abundant in the homosphere predominate over nitrogen and oxygen in the heterosphere, and create the helium and hydrogen belts before escaping altogether from the exosphere. Author

N66-19184# Centre National de Recherches de l'Espace, Brussels (Belgium).
THE STRUCTURE OF THE UPPER ATMOSPHERE
M. Nicolet Jan. 1964 53 p refs Presented at the Symp. on Results of the IGY-IGC, Los Angeles, 1963 *Its* Notes Preliminaires No. 39
CFSTI: HC $3.00/MF $0.50

The temperature, density, and composition of the upper atmosphere, and the factors influencing their variations are discussed. Data gathered during and following the IGY are stressed, especially data from the Sputnik, Vanguard, and Explorer satellites. Dissociations and recombinations of oxygen and nitrogen molecules and compounds were found to have a diurnal variation, dependent upon ultraviolet radiation. Mean molecular mass fluctuation was determined to be a parameter in vertical density distribution. This fluctuation was correlated with solar radiation in a 27-day sunspot cycle; it was shown that density has both a diurnal and a 27-day oscillation. Equations are given for density, diffusion, day- and night-time temperatures, the 27-day cycle temperature variation, and for heat flux density. N.E.N.

N66-19217# Royal Inst. of Tech., Stockholm (Sweden).
ON THE DISTRIBUTION OF ELECTRIC FIELDS IN THE MAGNETOSPHERE
Lars P. Block [1965] 33 p refs Submitted for Publication (Rept.-65-10)

The magnetic storm theories of Alfvén, Axford and Hines, and Dungey imply that an electrostatic potential difference exists across the magnetosphere. The detailed distribution of the resulting electric fields is, as yet, unknown. The present study is an attempt to solve this problem assuming that a plasma with continuous energy spectrum is injected, by some unknown mechanism, into the magnetosphere. It is shown that space charges will occur due to the different forbidden regions for particles of different charge and energy. The space charges will tend to suppress the applied potential and push the field towards the outer parts of the magnetosphere leaving a fieldfree region in the center. The size of the fieldfree region depends on the applied potential and the density and spectrum of the injected particles. In a first tentative approximation the auroral zone is found to be situated at an L-value, which is 52% larger than the L-value of the fieldfree boundary. Author

N66-19222# Joint Publications Research Service, Washington, D. C.
ORGANIC MATTER IN THE ABYSSAL SEDIMENTS OF THE BLACK SEA
V. N. Florovskaya and Yu. N. Gurskiy 23 Feb. 1966 14 p refs Transl. into ENGLISH from Geokhimiya (Moscow), no. 1, Jan. 1966 p 123–128
(JPRS-34260; TT-66-30701) CFSTI: $1.00

A luminescent–bituminological, chemical and spectral study of the organic matter of the abyssal sediments of the Black Sea were studied. The material used in the study consisted of samples of 14 cores of bottom deposits selected from a series of stations with depths from 400 to 2200 meters. Two groups of cores were distinguished: (1) cores with sharp variations in the content of the bitumoids, and (2) cores with rather uniform distribution of bitumoids. Infrared absorption spectra revealed the presence of high molecular, long chain compounds of the acid type. The luminescence spectra revealed the presence of highly condensed aromatic hydrocarbons. It is concluded that abyssal sediments of the Black Sea experiences great variation both with respect to the groups of compounds which it contains and the character of their distribution in the sediments. H.S.W.

N66-19243# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Research Div.
[BASIC RESEARCH ON THE PHYSICAL AND MECHANICAL PROPERTIES OF SNOW, ICE, AND FROZEN GROUND] Quarterly Progress Report, Aug.–Oct. 1965
[1965] 6 p refs
(AD-625745) CFSTI: HC $1.00/MF $0.75

The mission of the research division is to conduct basic research on the physical and mechanical properties of snow, ice, and frozen gound and their interrelationship with climatic and meteorological phenomena in order to support and improve the United States' military capability in cold regions. TAB

N66-19248# Geotechnical Corp., Garland, Tex.
OPERATION OF TFSO Quarterly Report No. 2, 1 Aug.–31 Oct. 1965
12 Nov. 1965 53 p refs
(Contract AF 33(657)-14444; ARPA Order 624)
(TR-65-129; AD-625469) CFSTI: HC $3.00/MF $0.50

Project VT/5055 includes the operation, evaluation, and improvement of the Tonto Forest Seismological Observatory located near Payson, Arizona. It also includes a discussion of special seismological investigations using data recorded by eight Long-Range Seismic Measurements Project seismological stations operating in an extended array configuration around the observatory. Author (TAB)

N66-19256# Research Triangle Inst., Durham, N. C.
RESEARCH DIRECTED TOWARD THE STUDY OF SEISMICITY IN THE SOUTHEASTERN UNITED STATES Annual Report, Dec. 15, 1964–Dec. 15, 1965
John W. Minear 5 Jan. 1966 35 p refs
(AD-625966) CFSTI: HC $2.00/MF $0.50

Principle research activities during the period of December 15, 1964 to December 15, 1965 were concerned with (1) local epicenter location, (2) long range refraction, (3) computation of crustal models from gravity data and surface wave dispersion, and (4) computation of P-Residuals. Several epicenters were located in the Southern Appalachians using data from Vela standard and mobile stations. P-Residuals have been computed for about 500 earthquakes recorded at Chapel Hill, North Carolina and the Cumberland Plateau Sesimological Observatory. A systematic sinusoidal deviation of the residuals with epicentral distance has been observed. Magnitude, focal depth, and energy release for several earthquakes previously reported have been calculated. Estimates of crustal thickness in the Southeastern United States from gravity data using the basic sin x/x method have been made. A derivation of the sin x/x method using the concept of sampling by an infinite Dirac comb is developed. Results of refraction work in North Carolina using local quarry blasts is presented. Some preliminary results of participation in the East Coast On-Shore Off-Shore Experiment are also given. Several computer programs were developed during the course of study. These include epicenter location, P-Residual computation, mass anomaly computation from gravity anomalies, autoregression of time-series data, and the computation of phase velocities by bandpass filtering. Author (TAB)

N66-19258# RAND Corp., Santa Monica, Calif.
SIMPLIFIED NORMAL MODE TREATMENT OF LONG-PERIOD ACOUSTIC-GRAVITY WAVES IN THE ATMOSPHERE
W. C. Meecham Nov. 1965 38 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4732-ARPA; AD-625232) CFSTI: HC $2.00/MF $0.50

A discussion of the effects of geometric dispersion due to stratification of the atmosphere on low-frequency mechanical waves generated by nuclear explosions. It is found that the pressure signal can be divided naturally into an early-arriving acoustic-gravity portion and a later acoustic portion, both portions being inversely proportional to the range (geometric spreading included). At very great ranges, however, portions of the gravity wave fall off faster by r(1/6); the effect of dispersion is to reduce the signal by r (−1/2). Most of the signal is composed of many propagating modes which, at a given range and time, will each demonstrate a characteristic frequency. A simplified treatment of the model picture is presented, along with the argument that a ray treatment for the high-frequency portion is appropriate.
Author (TAB)

N66-19259# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
REDUCTION PROCEDURES FOR ABSOLUTE DIRECTION AND GEODETIC AZIMUTHS FROM OPTICAL OBSERVATIONS OF SATELLITES
Lawrence A. Gambino and Armando Mancini Oct. 1965 25 p refs
(GIMRADA-RN-14; AD-625356) CFSTI: HC $1.00/MF $0.50

The azimuth reduction technique from satellite data presented in this report is developed with the aid of matrix algebra. It is fully general in that provisions are made for correlated observations. The reductions represent a rigorous least squares approach to the reduction of optical data gathered from satellite observations. The matrix equations are outlined in such a fashion that they can easily be used in the development of computer programs to perform azimuth reductions from simultaneous observations of satellites from two widely separated ground stations. Author (TAB)

N66-19384# Washington Univ., Seattle. Dept. of Atmospheric Sciences.

TRANFORMATION OF THE ATMOSPHERIC BOUNDARY LAYER OVER INHOMOGENEOUS SURFACES

Mikio Miyake Oct. 1965 74 p refs *Its* Scientific Rept.-6 (Contract Nonr-477(24))

(AD-626630) CFSTI: HC $3.00/MF $0.75

A survey is given of previous theoretical investigations of the development of an internal boundary layer in turbulent flow over a surface of variable roughness. On the basis of Monin and Kazanski's plume propagation concept, a new formula is derived which predicts the growth of the internal boundary layer under diabatic conditions. Wind and temperature profiles observed in air flowing across an artificial pond on the surface of a sheet of sea ice (near Point Barrow, Alaska) are used to test the new model, and it is found to give at least a qualitative prediction of the features of the internal boundary layer. The direction in which further refinement of the theory seems promising is indicated. Author (TAB)

N66-19388# Centre National de Recherches de l'Espace, Brussels (Belgium).

INTRODUCTION TO THE STUDY OF AERONOMY, PART 1 [INTRODUCTION A L'ETUDE DE L'AERONOMIE (1ere PARTIE)]

Marcel Nicolet [1960] 47 p refs In FRENCH *Its* Notes Preliminaires No. 16

CFSTI: HC $2.00/MF $0.50

The state of the art is briefly reviewed along with general knowledge concerning atmospheric density and temperature, molecular mass, the atmospheric regions, and the ionosphere. The composition of the homosphere is discussed, and tables are presented showing the relative proportions of the primary and secondary constituents, in terms of gases, molecules, and isotopes. Further, the normal physical conditions of the homosphere are described, and numerical values are given for temperatures, pressures, densities, and molecular concentrations from 30 to 100 km. A photochemical theory is proposed for the dissociation of oxygen, and it is applied to the study of ozone formation, to a determination of atomic oxygen duration, and to a calculation of atomic oxygen concentrations from 100 to 120 km. Finally, the conditions under which a temperature gradient can exist and maintain itself in the thermosphere and at higher altitudes are determined, and energy fluxes in the thermosphere are calculated. Transl. by D.T.

N66-19389# Centre National de Recherches de l'Espace, Brussels (Belgium).

INTRODUCTION TO THE STUDY OF AERONOMY, PART 2 [INTRODUCTION A L'ETUDE DE L'AERONOMIE (2eme PARTIE)]

Marcel Nicolet [1961] 75 p refs In FRENCH *Its* Notes Preliminaires No. 19

CFSTI: HC $3.00/MF $0.75

The effects of solar radiation absorption on photodissociation and photoionization are studied; and the absorption properties of both the primary and secondary constituents of the atmosphere are determined, for X-radiation from 1 to 100 Å and for ultraviolet above and below 1000 Å. The absorption spectrum of molecular oxygen is analyzed, and the results are applied to the study of other molecules, i.e., water, ozone, carbon dioxide, and nitrogen. Also, for these same molecules, the spectral range from photodissociation to photoionization is determined. Black body and solar emission spectra are compared; and the special effects of the Lyman α and Lyman β wavelengths are investigated. Finally, the general effects of solar ultraviolet and X-radiation are discussed, and variations in solar emissions are considered. Transl. by D.T.

N66-19390# Centre National de Recherches de l'Espace, Brussels (Belgium).

INTRODUCTION TO THE STUDY OF AERONOMY, PART 3 [INTRODUCTION A L'ETUDE DE L'AERONOMIE (3eme PARTIE)]

Marcel Nicolet [1961] 48 p refs In FRENCH *Its* Notes Preliminaires No. 20

CFSTI: HC $2.00/MF $0.50

An elementary theory, based on a mathematical model of elastic spheres, is enunciated in order to investigate the collisions and reactions of the various atmospheric particles. It is applied to the study of the following processes: (1) elastic collisions between electrons and neutral particles, and between ions and neutral particles; (2) radiative recombination; (3) recombination by triple collision; (4) displacement of atoms in the formation of molecules; and (5) charge transfer between ions and atoms. The photochemistry and photodissociation of molecular oxygen and nitrogen is studied, and the results are used in an examination of nitric oxide formation by triple collision. The conditions are determined for the formation of atomic nitrogen and nitric oxide in the ionosphere and mesosphere; and the production of hydrogen by the dissociation of water and methane is discussed. Transl. by D.T.

N66-19391# Centre National de Recherches de l'Espace, Brussels (Belgium).

INTRODUCTION TO THE STUDY OF AERONOMY, PART 4 [INTRODUCTION A L'ETUDE DE L'AERONOMIE (4eme PARTIE)]

Marcel Nicolet [1961] 50 p refs In FRENCH *Its* Notes Preliminaires No. 21

CFSTI: HC $2.00/MF $0.50

The various processes which effect the formation of the D, E, and F layers in the ionosphere are studied. These processes include solar radiation absorption, electron distribution, and electron concentration in the presence of negative ions or charge transfer. Laws are proposed describing the vertical distribution of absorption and of electrons under the conditions of normal ionization; and mathematical models are developed for the different ionization processes in each layer.

Transl. by D.T.

N66-19393# IIT Research Inst., Chicago, Ill.

BEHAVIOR OF ROCKS AND SOILS UNDER HIGH PRESSURE Final Report, 1 Jun. 1964–1 Aug. 1965

B. W. Paulding, R. H. Cornish, B. W. Abbott, and L. A. Finlayson Kirtland AFB, N. Mex., AF Weapons Lab., Dec. 1965 104 p refs

(Contract AF 29(601)-6411)

(AFWL-TR-65-51; AD-626378) CFSTI: HC $4.00/MF $0.75

This report describes a program which was directed toward developing a capability suitable for generating engineering data on the high pressure mechanical properties of geologic materials. To provide the greatest possible contribution, this effort concentrated on three of the most important deficiencies in high pressure experimental technology: (1) development of a system capable of accepting relatively large samples so that more-nearly representative data may be obtained than with the smaller samples used previously, (2) development of a system

suitable for monitoring the strains of highly deformable geologic materials, and (3) development of an encapsulating technique for soils. Each of these objectives was attained to a certain degree. Specimens up to three inches in diameter were subjected to fluid pressures of several kilobars. The deformation of soil was measured with a potentiometric slidewire device. An encapsulating technique was developed for soils which was suitable up to about two kilobars. Further refinements are necessary, but it appears that the more important of the limitations of past studies have been overcome.
Author (TAB)

N66-19394# RAND Corp., Santa Monica, Calif.
ON THE DERIVATION OF BOOKER'S QUARTIC FROM APPLETON-HARTREE EQUATION
H. Unz Sep. 1965 14 p refs
(P-3222; AD-626676) CFSTI: HC $1.00/MF $0.50

The Booker's quartic equation is derived directly from the Appleton-Hartree equation of the magneto-ionic theory, by using tensor analysis methods and transformation of coordinates.
Author (TAB)

N66-19398# Texas Instruments, Inc., Dallas. Science Services Div.
ARRAY RESEARCH: MATRIX-MULTIPLY DETECTION PROCESSING OF ARRAY DATA Special Report No. 8 (Preliminary)
Aaron Booker 13 Oct. 1965 28 p refs
(Contract AF 33(657)-12747; ARPA Order 104-60)
(AD-626408) CFSTI: HC $2.00/MF $0.50

Discussed is a probabilistic method for processing the output data of an array of seismometers with the aim of detecting earthquake or underground nuclear blast signals in the presence of ambient seismic noise. The method is based on the assumption that the array output is Gaussian with mean zero and known convariance matrix Ω_1 or Ω_2, depending on the absence or presence of signal. A detailed discussion of the processing results and test statistics is presented. M.R.W.

N66-19401# Texas Instruments, Inc., Dallas.
ARRAY RESEARCH Semiannual Technical Report, 15 Nov. 1964-15 May 1965
Robert Roden, Sam Rodgers, John Burg, John Hoffman, Aaron Booker et al 3 Jun. 1965 153 p refs
(Contract AF 33(657)-12747; ARPA Order 104-60)
(SATR-3; AD-625556) CFSTI: HC $5.00/MF $1.25

Deep-well seismic data recorded at UBO in September/October 1964 are used to estimate the capabilities of three 3-element vertical arrays and one hypothetical 6-element vertical array. The application of deconvolution and autocorrelation techniques to three ensembles of earthquake records from the multi-channel processor at CPO is being studied. Statistics and discrepancies between observed and USC and GS reported origin times, magnitudes and depths of focus are examined. A description of the mathematical operations and computer programs required to perform probabilistic processing is given. Four multichannel filter systems for CPO were designed using the full array and three partial arrays. Information concerning the recording and preliminary processing and analysis of a 20-min ambient seismic noise sample from the ring array, the large cross array and a 3-component seismometer at Tonto Forest Seismological Observatory is given.
TAB

N66-19416# Geotechnical Corp., Garland, Tex.
COMPARISON OF SEISMOGRAPH SYSTEMS AT UBSO
Frank F. Seymour 3 Nov. 1965 83 p refs
(ARPA Order 624)
(TR-65-124; AD-626529) CFSTI: HC $3.00/MF $0.75

Five seismograph systems that are routinely operated at the Uinta Basin Seismological Observatory were evaluated to determine their relative capabilities in detecting teleseismic P-wave arrivals. This evaluation includes a detailed analysis of microseismic background noise, signal characteristics, and signal-to-noise ratios, as recorded on a single element of the surface array of seismographs, both the filtered and unfiltered summation of the outputs of the elements of the surface array, the shallow-hole, and the deep-hole seismograph systems. In addition, system magnitude residuals relative to magnitudes reported by the USC and GS as well as apparent arrival time residuals are presented.
Author (TAB)

N66-19550# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ELECTRONIC AND IONIC REACTIONS IN ATMOSPHERIC GASES Yearly Technical Summary Report, 1 Sep. 1964-31 Aug. 1965
R. F. Stebbings, M. A. Fineman, J. W. Mc Gowan, and B. R. Turner 1 Dec. 1965 133 p refs
(Contract DA-49-146-XZ-354)
(DASA-1708; GA-6699; AD-625480) CFSTI: HC $4.00/MF $1.00

Collisions involving charge transfer and charged rearrangement between some of the positive ions and neutral molecules present in the earth's upper atmosphere have been investigated in a crossed beam experiment at energies within the range 2 to 200 eV. The charged reaction products are identified in a mass spectrometer, and absolute cross sections for their production are obtained. Interpolation between these values and those obtained at thermal energy in afterglow experiments provides information on the variation of the cross sections with energy in the intervening energy interval. The influence of excited ions is examined in some detail. Ionization of N_2 and H_2 just above threshold has been investigated using monoenergetic electrons obtained with a 127-deg electrostatic energy selector. In both cases there was evidence of ionization occurring by autoionization as well as direct ionization. The agreement between our electron impact results and those obtained by photoionization for the autoionization processes is compared. In the case of H_2, we have interpreted the structure in the second-derivative electron impact spectrum to be due to the rotational states of H_2 and H_2^+ taking part in the ionization process.
Author (TAB)

N66-19620*# Esso Research and Engineering Co., Linden, N. J.
[TESTING OF THE RELIABILITY OF ALKANES AS BIOLOGICAL INDICATORS AND DEVELOPMENT OF REFERENCE DATA ON ALKANES OF VARIOUS ORIGINS] Final Report
28 Jan. 1966 39 p refs
(Contracts NASw-508; NASw-1170)
(NASA-CR-71055) CFSTI: HC $2.00/MF $0.50 CSCL 08D

Repeated tests of the sensitivity of analytical methods show that reproducible characterizations can be obtained of alkanes which comprise 10^{-8} or more parts by weights of samples. Contaminants are the major source of errors in organic geochemical investigations, and the contamination of samples

most frequently occurs prior to the receipt of samples in the laboratory. Analyses of extracts from different segments or portions of a sample provide data for assessing the levels and evaluating the effect of contamination. Analyses of alkanes from Paleozoic and Precambrian rocks indicate that life has persisted for more than 3 billion years on earth. Ordinary chondrites, also, contain biological alkanes as well as optically active organic nonhydrocarbons, but results do not rule out the likelihood that these meteorites were contaminated with terrestrial materials. Analyses of alkanes and aromatic hydrocarbons from fragments of the Orgueil, Type I carbonaceous chondrite, are suggestive of an indigenous and biological origin for some meteoritic carbon compounds. Author

N66-19655*# Stanford Univ., Calif. Design Div.
MULTIVATOR DESIGN STUDIES
Sep. 1965 115 p refs
(Grant NsG-81-60)
(NASA-CR-70723) CFSTI: HC $4.00/MF $0.75 CSCL 08M

Seven reports are given representing concentrated studies of specific problems encountered in designing an instrument for the (multivator) detection of extraterrestrial life. The first report deals with the problems of sample collection and includes a discussion of laboratory techniques which would be useful in the development of a sampling device. The second report describes a sample collector which would be useful primarily for earth based testing of life detection instruments requiring the input sample in the form of an aerosol. The third report involves delivering and metering minute quantities of a liquid in the processes of an automated wet chemistry laboratory. The fourth and fifth reports concern an investigation into the types of mechanical actuators suitable for use in an application placing a premium on low weight and high energy density. The sixth report involves a study of the problems encountered in driving a high friction, sliding disc valve of the type used in gas chromatography. The seventh report investigates the dynamic characteristics of a pneumatically actuated version of the multivator in order to determine the effects of pressure levels and geometry on its performance. C.T.C.

N66-19760*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MEASUREMENTS OF WINDS BY CHEMICAL RELEASES IN THE UPPER ATMOSPHERE
Hugh Wilson Morgan 3 Dec. 1965 37 p refs
(NASA-TM-X-53363) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Upper atmospheric winds are of importance to the designers of space vehicles as well as to geophysicists. For this reason a number of organizations have begun to study winds above 80 kilometers by releasing into the upper atmosphere chemicals which luminesce either by the action of sunlight or by a reaction with naturally occurring molecules. Seventy-seven of these releases were studied in an effort to determine a statistical model for wind velocities between 80 and 200 kilometers at mid-latitude sites. Author

N66-19775# Denver Univ., Colo. Dept. of Physics.
BALLOON BORNE INFRARED STUDIES Final Report, 1 Sep. 1960–31 Aug. 1965
David G. Murcray, Frank H. Murcray, and Walter J. Williams 30 Sept. 1965 39 p refs
(Contract AF 19(604)-7429; ARPA Order 363-62)
(DRI-2288; AFCRL-65-775; AD-625349) CFSTI: HC $2.00/MF $0.50

The primary objective of this program was to obtain experimental data concerning the infrared spectral transmittance of the earth's atmosphere at high altitudes. Data pertinent to this objective were obtained by studying the variation of the infrared solar spectrum with altitude. Instrumentation capable of measuring selected portions of the infrared solar spectrum while it is carried aloft by balloons was constructed and flown a number of times as part of this program. A description of the instrumentation used to obtain these data and a summary of the flights made during the program are given. A secondary objective was to measure the variations with altitude of the infrared radiation emitted by the earth and its atmosphere. These measurements were also made with balloon borne instruments. The instrumentation used for making these measurements is described and a summary is also given of the flights made with this instrumentation. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-18511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSDUCER OF SPECTROMETER OF ELECTRONIC PARAMAGNETIC RESONANCE
Ya. S. Lebedev and O. M. Taranukha 9 Dec. 1965 1965 6 p
Transl. into ENGLISH of Soviet Patent no. 168347 (Appl. no. 888522/26-25, 18 Mar. 1964) 2 p
(FTD-TT-65-1171/1+2+4; AD-625009) CFSTI: HC $1.00/MF $0.50

The object of the invention is a transducer of a spectrometer of electronic paramagnetic resonance consisting of a volumetric resonator and an ampoule with the specimen inside of it. For the purpose of locating the field of UHF at the position of the specimen on the ampoule there is placed a spiral of conductive materials. Author (TAB)

N66-18559# Aerospace Corp., El Segundo, Calif.
QUANTITATIVE RADIANT INTENSITY MEASUREMENTS USING PHOTOGRAPHIC AND ELECTRONIC IMAGING
Eugene B. Turner Nov. 1965 27 p refs
(Contract AF 04(695)-469)
(BSD-TR-65-203; TDR-469(5810-73)-1; AD-625855) CFSTI: HC $2.00/MF $0.50

The subject of this paper is essentially the use of a camera, either photographic or television, for obtaining quantitative radiometric data. Under some conditions the camera is to be preferred to a device such as a radiometer, and often a camera is the only feasible instrument for making radiometric measurements. For measurements using photographic film it is necessary to consider the film characteristics such as the H and

D curve, the spectral sensitivity, etc. The special case of the recording of point images is discussed in detail. For this type of image the diameter of the exposed spot on the film grows with the intensity. This technique, used for over 50 years by astronomers, has a large dynamic range and a fair accuracy. Calibration and data reduction methods are explained. Television systems have several advantages such as real time display, magnetic tape recording, and high sensitivity. Some disadvantages are limited dynamic range and low resolution. References are made to recent papers on the use of vidicon and image-orthicon systems for quantitative measurements.
Author (TAB)

N66-18611# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
DASA FALLOUT AND TRANSIT DOSE RATE MEASUREMENT SYSTEM
James E. Brown and R. I. A. Webb Edgewood Arsenal, Md., Nucl. Defense Lab., Dec. 1965 118 p refs
(Contract DA-49-146-XZ-292)
(NDL-TR-71; DASA-1688; AD-627077) CFSTI: HC $4.00/MF $0.75

The report presents the results of a study and design effort that demonstrates the feasibility of an improved system for the measurement and collection of residual radiation dose rate information. The improved system consists of as many as 100 data collection points at which up to 200 detectors may be located. Data are telemetered to a centrally located online computer for real time computation. Suitable performance characteristics and system compatibility have been demonstrated by an experimental detector station fabricated for test and evaluation. Other system components were selected from available off-the-shelf commercial items. Included in the system is a provision for differentiation between the dose rate contributed by the deposited fallout and the transit dose rate.
Author (TAB)

N66-18616# Princeton Univ., N. J.
AN INVESTIGATION OF THE APPLICATION OF FEEDBACK AND COMPARATOR CONCEPTS TO SENSITIVE SEMICONDUCTOR INSTRUMENTS Final Report, Oct. 1962–Feb. 1965
Enoch J. Durbin, Gerald J. Born, and Kazuaki Tahashima Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Oct. 1965 135 p refs *Its* Rept.-741
(Contract AF 33(657)-10069)
(AFFDL-TR-65-76; AD-626161) CFSTI: HC $4.00/MF $1.00

A theoretical and experimental investigation was made of the application of feedback to semiconductor energy sensors. By the application of feedback the sensor becomes an energy comparator with improved dynamic response. The comparator characteristics are determined by their physical (mechanical) characteristics towards their environment and are practically independent of the electrical sensor characteristics. Simple compensation over a wide temperature is then often possible. Practical applications are discussed and evaluated such as, temperature measurement, RMS measurement, pressure measurement and radiation measurement.
Author (TAB)

N66-18630# Geotechnical Corp., Garland, Tex.
GALVANOMETERS, PROJECT VT/072
B. M. Kirkpatrick and John Masse 17 Dec. 1964 59 p
(Contract AF 33(657)-9967; ARPA Order 104-60)
(TR-64-133; AD-626528) CFSTI: HC $3.00/MF $0.75

Air damping in long-period galvanometers was reduced by a moving-magnet fixed-coil design, wherein the moving magnet is operated in an evacuated glass housing. The susceptibility of this arrangement to influence by local magnetic fields was minimized by use of a rotor assembly employing a multiplicity of magnetic poles evenly distributed around two ring magnets. Magnetic polarization of materials in the immediate vicinity of the ring magnets was controlled by continuous high-frequency degaussing. Testing of the moving-magnet galvanometer was not fully completed. Preliminary tests indicate that the influence of local magnetic fields has not been entirely eliminated. There appears to be no advantage to the moving-magnet galvanometer over the usual moving-coil design at free periods up to 100 sec. However, the moving-magnet galvanometer shows promise at periods in excess of 100 sec where the air damping in normal moving-coil designs becomes excessive. For dependable use, the galvanometer needs to be properly oriented in the local magnetic field. A computing or dynamometer-type galvanometer has been constructed and tested for use in seismic data analysis where a power-level indication is of interest and in signal multiplication and correlation.
TAB

N66-18648# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands). Advies Bureau der Genie.
ANALYSIS OF THE ITEMS RECEIVED DURING THE VISIT TO THE SEVENTH INTERNATIONAL SYMPOSIUM "HIGH-SPEED PHOTOGRAPHY", 12–18 SEPTEMBER AT ZURICH, SWITZERLAND [ANALYSE VAN DE GEGEVENS VERKREGEN BIJ HET BEZOEK AAN HET ZEVENDE INTERNATIONALE SYMPOSIUM "HIGH-SPEED PHOTOGRAPHY" VAN 12–18 SEPTEMBER TE ZURICH, ZWITSERLAND]
R. W. Trense Oct. 1965 16 p In DUTCH *Its* Rept.-123
(TDCK-44195) CFSTI: HC $1.00/MF $0.50

Various reports presented at the symposium are briefly reviewed. Topics covered include new methods of flash-bulb placement, schlieren photography and shadow graphs, X-ray impulse techniques used with high-speed pictures for detonation waves, hypervelocity impact phenomena, tests of metal plate influences on explosive accelerations using the moire effect, development of image converters as high-speed cameras, experiments with a pulsed electron beam instrument, high-speed photography using ultrasonic vibrations, high-speed cinematography of explosive forming, small displacements measurements, and road safety research problems. A critical evaluation of these topics is presented, as well as ideas for future research.
Transl. by J.O.

N66-18703# Johns Hopkins Univ., Baltimore, Md.
PRECISION X-RAY SPECTROSCOPY
J. A. Bearden [1965] 14 p refs Presented at the Intern. Conf. on Phys. of X-ray Spectra, Cornell Univ., Ithaca, N. Y. Jun. 1965
(Contract AT(30-1)-2185)
(CONF-650657-1) CFSTI: HC $1.00/MF $0.50

The high resolving power of the double crystal spectrometer is discussed in terms of the geometry of its crystals. The precision required in the alignment and crystal tilt angles in order to achieve an instrumental precision greater than one part per million in X-ray wavelengths is discussed. The correct form of the expression for correcting these values for finite vertical divergence is pointed out. An optical-level procedure

for adjusting and aligning a double-crystal spectrometer and a simple method of grinding crystals parallel to a desired plane for testing and use are described. NSA

N66-18786# Brookhaven National Lab., Upton, N. Y.
TEMPERATURE CONTROLLER
D. Potter and D. Stephani 23 Mar. 1965 10 p
(Contract AT(30-2)-GEN-16)
(BNL-8943) CFSTI: HC $1.00/MF $0.50

A simplified block diagram and a schematic diagram are given for a temperature controller operating as a null device. The power control unit, off-scale detector, proportional signal, integral, rate signal, and output power supply are discussed. NSA

N66-18802# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
MAGNETIC FIELD GAGE AND STABILIZER [MERICE A STABILISATORY MAGNETICKYCH POLI]
J. Kluhanek and F. Dobias 1965 20 p refs In CZECHSLOVAKIAN
(UJV-1339/65)

For the accurate measurement of the magnetic fields of a spectrometer and deflection magnet, a series of instruments were developed that make possible not only measurement but also stabilization to more than 5×10^{-5}. The instruments work on the principle of magnetic resonance. The field measurement device is designed for the measurement of homogeneous magnetic fields in the area from 0.1 to 1.9 T. It consists of 5 exchange probes, and the signal is observed on an oscillograph. The stabilizer, with a range of 0.23 to 0.73 T, is built into the multispectrograph. It is remotely operated and controlled with a stable generator of step-wise harmonic oscillations. The long-term stability is better than 10^{-6}. The stabilizer works in the range from 0.77 to 1.22 T. In the mechanical part, it possesses some improvements such as a simple control of the field stabilization. It is provided with an instrument that makes possible the reading of the function break.
Author (NSA)

N66-18806# Sandia Corp., Albuquerque, N. Mex.
A SWEEP-FREQUENCY MULTIPOINT CALIBRATOR FOR FRQUENCY-MEASURING DEVICES
R. G. Bemis Mar. 1965 19 p ref
(Contract AT(29-1)-789)
(SC-TM-64-921) CFSTI: HC $1.00/MF $0.50

A system is described for rapid and accurate calibration of frequency measuring devices over the frequency range of 1000 to 12,000 megacycles. This system is composed of a sweep-frequency oscillator, a harmonic transfer oscillator, a standard-frequency source, an r-f detector, and a readout oscilloscope. This system can increase the efficiency of calibrating frequency-measuring devices. Author (NSA)

N66-18851# Sandia Corp., Albuquerque, N. Mex.
A VOLTAGE BREAKDOWN DETECTOR
E. L. Shaffstall Feb. 1965 7 p
(Contract AT(29-1)-789)
(SC-TM-64-2154) CFSTI: HC $1.00/MF $0.50

A description is given of the application of a tunnel diode voltage level detector to monitor components for voltage breakdown during pulse testing. Author (NSA)

N66-18867# Commissariat a l'Energie Atomique, Grenoble (France).
TEST OF ABSOLUTE ANALYSIS BY SPARK SOURCE MASS SPECTROMETRY [ESSAI D'ANALYSE ABSOLUE PAR SPECTROMETRIE DE MASSE A ETINCELLES]
Michel Desjardins (Ph. D. Thesis—Grenobel Univ.) [1965] 45 p refs In FRENCH
(CEA-R-2721)

A graphical method was used to study the linearity of response of the MS 7 mass spectrometer for impurity determinations over a concentration range of 1 to 1,000 ppm. This method consists in transforming optical density measurements into "true intensities," which are plotted on a log paper against the exposures. A moving transparent ruler graduated at the inverse scale of the exposures allows one to determine directly on the graph, the concentration of impurities in ppm. This method was used for the determination of sensitivity coefficients in standard samples such as Al, Fe, Cu, Ni, Zr, and nonconducting powders like SiO_2 and Al_2O_3. This study shows that, for the samples studied, the sensitivity coefficients are practically independent of the matrix and the concentration. Moreover, the results show the possibility of obtaining an absolute analysis by spark source mass spectrometry. Author (NSA)

N66-18908# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
INFLUENCE OF CO-CO_2 ENVIRONMENTS ON THE CALIBRATION OF CHROMEL-P-ALUMEL THERMOCOUPLES
H. E. Mc Coy, Jr. [1965] 18 p refs Presented at the Meeting on Thermocouple Technol. and the Effects of Nucl. Radiation on Thermocouples, Washington, D. C.
(Contract W-7405-ENG-26)
(ORNL-P-1070; CONF-650204-4) CFSTI: HC $1.00/MF $0.50

Observations are reported of the behavior of Chromel-P–Alumel thermocouples in CO, CO_2–5% CO, and CO_2 environments. Emf drift determinations, carbon analyses, and metallographic examinations were carried out on the exposed specimens. The results indicate that the thermocouple output decreases with exposure at high temperatures, and that the changes are greater than in air. The mechanism of the changes is probably removal of Cr from solution by oxidation in CO_2-rich mixtures, and carburization and oxidation in CO-rich mixtures. NSA

N66-18928# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SIMPLE CRYOSTAT FOR COOLING OF NUCLEAR RADIATION SEMICONDUCTOR DETECTORS
W. Przyborski Dec. 1964 8 p refs
(INR-583/II/PL)

The design of a simple cryostat for nuclear radiation semiconductor detectors applications at low temperatures is described. In this cryostat, a sample temperature of about 90°K can be achieved, using 1/4 liter of liquid nitrogen only, and 1 liter suffices to maintain this temperature for 5 to 7 hours. The appropriate cooling time is 20 min, and 5 to 7 min is required to warm up the previously cooled sample to the room temperature. Author (NSA)

N66-18929# Academia R. P. R. Bucharest (Romania). Institutul de Fizica Atomica.
SEMI-AUTOMATIC MEAN GAP-LENGTH METER FOR IONISATION MEASUREMENTS
C. Bercea, I. Ciuc, E. M. Friedlaender and H. Totia Apr. 1965 5 p refs
(IFA-CR-53)

Assuming that above a certain minimum gap-length l_1 the distribution of gaps in particle tracks is exponential, a semi-automatic device was built yielding directly the average gap-length of gaps exceeding l_1 by means of a digitized eyepiece filar-micrometer. Author (NSA)

N66-18970# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
METHODS OF CALCULATING THE PULSE HEIGHT DISTRIBUTION AT THE OUTPUT OF A SCINTILLATION COUNTER
H. J. Gale and J. A. B. Gibson Sep. 1965 30 p refs
(AERE-R-5067)

A systematic approach has been made to the prediction of the pulse height distribution at the anode of the photomultiplier in a scintillation counter, arising from a distribution of electrons in the scintillator. Iterative procedures were developed for use with a digital computer to calculate the distribution exactly. A more convenient continuous algebraic function was derived and applied to extend the method to higher input energies. These methods were developed to explain the pulse height distributions observed with low and higher energy beta emitters in a liquid scintillation counter. The method can, however, be applied to any scintillation counter where the electron distribution in the scintillator is known. Author

N66-18971# European Atomic Energy Community, Brussels (Belgium).
DESCRIPTION OF A DOUBLE-DETECTOR LARGE-SURFACE SCINTILLATION PROBE [DESCRIZIONE DI UNA SONDA A SCINTILLAZIONE DI GRANDE SUPERFICIE A DOPPIO RIVELATORE]
G. Dominici and D. d'Adamo 1965 20 p In ITALIAN; ENGLISH summary
(EUR-2577.i) CFSTI: HC $1.00/MF $0.50

A portable scintillation alpha-beta detector of high sensitivity and counting efficiency for surface contaminations is described. The active detector surface made out of plastic scintillator and ZnS (Ag) has an area of 100 cm^2. Author

N66-19020# United Kingdom Atomic Energy Authority, Harwell (England). Photographic Group.
A MACRO CAMERA FOR THE PHOTOGRAPHY OF METALLOGRAPHIC SPECIMENS
E. M. Wittam Aug. 1965 17 p
(AERE-M-1640)

A pre-war Leitz "Panphot" camera microscope was modified into a macro-camera for the examination and photography of metallographic specimens using normal incident lighting. Author

N66-19102# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
A DETECTOR FOR A REPROCESSING CELL [DETECTOR PARA CELDA DE REPROCESAMIENTO]
Horacio Picard and Furio Costigliolo 1965 20 p refs In SPANISH
(CNEA-159) CFSTI: HC $1.00/MF $0.50

In processing irradiated combustible elements, it is often necessary to control the movement of highly radioactive liquid phases in tanks or ducts located in areas of limited access. One method of accomplishing this control consists of detecting the radiation level in the area of interest using a Geiger–Müller tube as a sensing element. The end of an active phase passage in a duct or the unloading of a tank can be registered by means of a luminous signal and/or a gauge conveniently located in a nonactive zone. This type of control has the advantage of no moving parts or delicate mechanisms that can suffer damages which are difficult to repair in situ due to the high radiation level present during the functioning of the plant. This paper describes equipment designed for this type of operation and consists of three miniature Geiger–Müller tubes that register the activity of an equal number of processes in a reprocessing cell. These detectors are connected to a system of luminous signals and a gauge which give complete information concerning the state of the process. Transl. by R.N.A.

N66-19131# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTACTLESS METHOD OF MEASURING AMPLITUDE AND FREQUENCY OF VIBRATIONS OF BLADES OF REVOLVING TURBINES, FOR EXAMPLE, GAS ONES
N. A. Yashkir 19 Oct. 1965 6 p Transl. into ENGLISH from Russian Patent no. 164968 (Appl. no. 827523/26-10, 28 Mar. 1963) 2 p
(FTD-TT-65-1012/1+2+4; AD-625792) CFSTI: HC $1.00/MF $0.50

The object of the invention is a contactless method of measuring the amplitude and frequency of the vibrations of the blades of a revolving turbine, for example, of a gas one, with the use of photoelectric pickups. Use is made of the infrared rays given off by the highly heated parts of the turbine blades. In the body of the turbine openings are made through which the flux of rays with the aid of an optical system and an optical wedge with a density changing directly proportionally in length, is projected onto the photosensitive element of the pickup the signal on the output of which is proportional to the parameters to be measured. Author (TAB)

N66-19141# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
TEMPERATURE MEASUREMENT IN A HIGH-TEMPERATURE X-RAY DIFFRACTOMETER
T. W. Baker, P. J. Baldock, and W. E. Spindler Oct. 1965 16 p refs
(AERE-R-4556)

A calibration procedure for the measurement of the diffracting surface temperature to 2000° C in a high-temperature attachment to a Philips diffractometer is described. This procedure gives an accuracy of ±30°C at 2000°C. The calibration has shown that the diffracting surface can be up to 150°C cooler than the bulk of the specimen. Author

N66-19153# Centre National de la Recherche Scientifique, Paris (France).
NEW ELECTRONIC SPECTROCOMPARATOR [NOUVEAU SPECTROCOMPARATEUR ELECTRONIQUE]

Roger Bouigue [1953] 12 p refs In FRENCH *Its* Publ. de l'Observatoire de Haute-Provence, v. 5, no. 47
CFSTI: HC $1.00/MF $0.50

The principles, operating parameters, and performance characteristics are given for an electronic spectrocomparator which is used for rapid and precise measurements of radial velocity. Its application to measurements of the star B 5848 are described. These results, it is pointed out, show that this star has a constant radial velocity. Pictures of the apparatus are included. Transl. by D.T.

N66-19237# Naval Boiler and Turbine Lab., Philadelphia, Pa.
INSTRUMENT STANDARDS
E. L. Lewis, ed. 1 Jul. 1965 341 p refs *Its* Ed. 12
(AD-624923) CFSTI: HC $7.00/MF $1.75

The Standard Plans contained in this binder constitute Naval Boiler and Turbine Laboratory Instrument Practice as of the Date of Issue. They represent only repetitive items, each test measurement system is designed according to its own requirements, the standards being used where applicable. The Standards specifically concerned with Flow Measurement have been removed from this volume and are being issued as a separate publication. The assembly of these standards into a separate volume has been done to facilitate their use by those whose primary area of interest is in the field of fluid flow measurement and calculation. Author (TAB)

N66-19240# Texas Instruments, Inc., Dallas. Science Services Div.
CUMBERLAND PLATEAU SEISMOLOGICAL OBSERVATORY Quarterly Progress Report No. 1, 1 May–31 Jul. 1965
15 Aug. 1965 27 p refs
(Contract AF 33(657)-14648; ARPA Order 624; Proj. Vela Uniform)
(AD-625552) CFSTI: HC $2.00/MF $0.50

The observatory is operated for the Air Force Technical Applications Center (AFTAC) under the sponsorship of the Advanced Research Projects Agency (ARPA) as part of program VELA UNIFORM. During these first three months of operation, routine analysis and operation of the station has continued and specific research studies on ambient noise, signal-to-noise ratios and detection capability have been initiated. In addition, a digital multichannel filter unit is being built by TI for installation early in 1966. This first quarterly progress report reviews the analysis, engineering and research tasks which have been performed or initiated during May, June and July of 1965. Author (TAB)

N66-19361# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF RECEIVING SURFACE DIMENSIONS ON THE BASIC CHARACTERISTICS OF METALLIC VACUUM BOLOMETERS
L. M. Artyukhovs'ka, L. S. Kremenchugs'kiy, A. F. Malnev, and O. V. Roytsina 6 Jan. 1966 13 p refs Transl. into ENGLISH from Uk. Fiz. Zh. (Kiev), v. 9, no. 11, 1964 p 1240–1247
(FTD-TT-65-922/1+2+3+4; AD-626954) CFSTI: HC $1.00/MF $0.50

The sensitivity and inertia of metallic vacuum bolometers were studied as functions of receiving surface area. Basic relationships were derived for calculations. The theoretical calculations give results in good agreement with experimental data. It is shown that the sensitivity threshold is proportional to the square root of the receiving-surface area only when the bolometer is cooled by radiation. When it is cooled by radiation and the thermal conduction of the film, the sensitivity is more strongly dependent on the width of the receiving element than on the length, while the converse applies for the inertia factor. Author (TAB)

N66-19373# Naval School of Aviation Medicine, Pensacola, Fla.
THE EFFECTIVENESS OF THE NAVAL AIR BASIC INSTRUMENT TRAINER
Richard S. Pomarolli 5 Nov. 1965 47 p refs *Its* Spec. Rept. 65-7
(AD-627218) CFSTI: HC $2.00/MF $0.50

The study evaluated the effectiveness of the Naval Basic Instrument Trainer (NavBIT) as it is currently used in the Basic and Radio Instrument Navigation Stages of Basic flight training. Findings are based on a detailed study of individual student reactions and on an intensive search of the pertinent literature. The study indicates that the Naval Basic Instrument Trainer is doing an effective job as an aid to teaching instrument flight, and that the expenditure for a more elaborate simulator would not be justified in terms of increased effectiveness. It also points out that the students themselves feel that the link trainer is adequately fulfilling its basic purpose of teaching procedures, scan, and the reading of instruments.
Author (TAB)

N66-19396# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
BASIC STUDIES OF ROTATING STALL AND AN INVESTIGATION OF FLOW-INSTABILITY SENSING DEVICES. PART II: INVESTIGATION OF FLOW-INSTABILITY SENSING DEVICES Final Report, Feb. 1964–Oct. 1965
Ewald F. Schroeder, Roy S. Rice, and Fred Dell'Amico Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., Oct. 1965 110 p refs
(Contract AF 33(615)-1240)
(AFAPL-TR-65-115, Pt. II; CAL-DF-1901-S-7; AD-625784)
CFSTI: HC $4.00/MF $0.75

The report describes the results of an experimental investigation of pure fluid flow-instability sensing devices that might be applied to the detection of incipient stall in jet-engine compressors. Various sensors employing two-branch probes and bistable fluid amplifiers were investigated. The results of dynamic tests, including operation at high temperatures, are described. The preferred configuration evolved exhibits good performance characteristics and offers a promising solution to pure fluid flow-instability sensing problems. Author (TAB)

N66-19403# Bausch and Lomb, Inc., Rochester, N. Y.
APPLICATION AND VERIFICATION OF MATHEMATICAL MODEL OF PHOTOGRAPHIC RECONNAISSANCE Interim Technical Report, 1 Jul.–31 Oct. 1965
Walter J. Wojcik Nov. 1965 21 p
(Contract AF 33(605)-2630)
(Rept.-8526-IR-1; AD-625319) CFSTI: HC $1.00/MF $0.50

The three major components of the Contrast Attenuator were studied in detail. These are the dichoric filter arrangement which was also breadboarded, the illumination source and optics, and the neutral density wedge system. A study of the Spatial Frequency Analyzer was made and a breadboard of the system set up. Some photographs illustrating spatial filtering were taken. Author (TAB)

N66-19437# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR X-RAY STRUCTURAL ANALYSIS OF RADIOACTIVE MATERIALS
Yu. I. Gribanov, A. G. Karmilov, and I. A. Lednev 28 Sep. 1965 7 p Transl. into ENGLISH from Russian Patent no. 155318 (Appl. no. 770211/25-8, 23 Mar. 1962) 3 p
(FTD-TT-65-977/1+2+4; AD-625748) CFSTI: HC $1.00/MF $0.50

A device for X-ray structural analysis of radioactive materials is presented. The device has the distinguishing feature that for the purpose of increasing the precision of the measurement a modulator is provided which accomplished the modulation of the X-ray beam in accordance with a law close to the sinusoidal. The modulator is designed in the form of a flat metallic disk eccentrically placed inside of a metallic ring, it is fastened at the point of continguity in such a way that the geometrical centers are displaced in different directions relative to the axis of rotation of the modulator. The modulator is designed in the form of a disk from material which along the circumference alternates in thickness with a change that depends on the angle of turn in accordance with sinusoidal law. TAB

N66-19461*# AiResearch Mfg. Co., Los Angeles, Calif.
CONTROL MOMENT GYRO OPTIMIZATION STUDY
G. W. Yarber, K. T. Chang, Joseph Kukel, B. F. Mc Kee, C. S. Smith et al Washington, NASA, Mar. 1966 169 p refs
(Contract NAS1-4439)
(NASA-CR-400) CFSTI: HC $2.00/MF $1.00 CSCL 17G

Future manned spacecraft will use momentum storage systems to minimize weight and power expenditures for their long termed missions. Primary applications will be in spacecraft stabilization systems, where control moment gyros or reaction wheels provide rate and attitude control by precessing or accelerating rotating flywheels. Secondary applications involve power conditioning equipment and other rotating machinery on the spacecraft. In view of the required development of momentum storage hardware for these applications, an optimization and preliminary design study of rotating assemblies and their associated components for minimum weight and power in the spacecraft environment was conducted. The most immediate use for these rotating components has been in the development of control moment gyroscopes for the spacecraft control systems, and control moment gyros thus provided the basis on which this optimization study was performed. This report includes the technical approach, the solution techniques, and the results of this optimization study. The data presented comprise the preliminary design of flywheels spinning to produce a wide range of angular momenta while maintaining minimum weight, size, bearing friction, and windage loss. Other areas that were considered include the maximizing of bearing life under extreme loading conditions, proper lubrication schemes for bearings in a vacuum environment, and flywheel drive motor design for spinup and constant speed operation. The data given for these design areas should be of considerable value in the future analysis of any rotating assembly where weight and power are critical. Author

N66-19531*# ITT Industrial Labs., Fort Wayne, Ind.
AN EXPERIMENTAL EFFORT TO IMPROVE THE NIMBUS HIGH RESOLUTION INFRARED RADIOMETER, VOLUME II Final Report, 1 May 1964–15 Feb. 1965
W. H. Wallschlaeger, P. C. Murray, P. R. Sargent, and R. V. Annable [1965] 125 p
(Contract NAS5-3683)
(NASA-CR-71093) CFSTI: HC $4.00/MF $1.00 CSCL 20F

Supporting data are presented for a study to improve the Nimbus infrared radiometer. These include: (1) circuit drawings; (2) a telemetry compendium; (3) calibration visicorder charts; (4) connector pin designations; (5) detector cell parameters; (6) field effect transistor data; (7) tunnel diode specifications; (8) mechanical and electrical properties of synthane G-10; and (9) mechanical and physical properties of titanium alloy wire. D.T.

N66-19570# Stanford Univ., Calif.
OPTICAL FLAT PLACEMENT ON ALMOST SPHERICAL GYRO ROTORS
Robert Victor Plank (M.S. Thesis) Aug. 1965 41 p refs
(Contract AF 33(615)-1411)
(AD-624661) CFSTI: HC $2.00/MF $0.50

This thesis discusses a technique of precise placement of an optical flat on an almost spherical gyro rotor. An initial flat is placed near the minimum axis of inertia of a sphere. The flat is replaced by successive polishing operations until the minimum axis becomes the maximum axis and a desired alignment of the flat, approximately perpendicular, with the maximum axis is achieved. Author (TAB)

N66-19601*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL DETERMINATION OF TELEVISION CAPABILITIES FOR MAKING NAVIGATIONAL MEASUREMENTS
Frank A. Pauli and Daniel M. Hegarty Washington, NASA, Mar. 1966 39 p refs
(NASA-TN-D-3360) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Maximum resolution and minimum perceptible contrast were measured and the accuracy of angular measurement was determined over a range of background lighting from 0.034 to 343 candela per square meter (0.01 to 100 foot lamberts). Television operating conditions and adjustments were found to have a large effect on the relative distance between images on the monitor screen; for maximum accuracy, therefore, it was necessary to obtain an angular calibration from the field of view when a measurement was taken. An additional calibration technique for correcting position distortion over the field of view decreased the error by a factor of 7. Maximum horizontal resolution was found to be 850 TV lines, corresponding to a distance of 0.0032 cm on the photocathode. The minimum perceptible contrast for a 0.020 cm spot on the photocathode was 5 percent; this contrast increased considerably for smaller spots. The use of both angular and positional correction calibration procedures yielded a maximum error of 0.27 percent in the measurement of the angular separation between two objects about 12-1/2° apart. Author

N66-19606*# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR ACOUSTIC SPECTRA COMPARATOR RECORDER (ASCOR) Final Report
Robert I. Morefield Jan. 1966 59 p *Its* Rept.-1267
(Contract NAS9-4636)
(NASA-CR-65243) CFSTI: HC $3.00/MF $0.50 CSCL 14B

This instruction manual describes the installation, operation and maintenance of the acoustic spectra comparator and recorder (ASCOR) system. The ASCOR system assists in the adjustment of the noise generator controls and records the actual acoustic levels within the acoustic test chamber at the Manned Spacecraft Center. The general performance characteristics are summarized, the specific functions of the compare and record modes are discussed, and the components and controls are defined. The six major subassemblies within the ASCOR console are shown, along with a block diagram depicting the functions of the various subassemblies. A system schematic is included, and system performance specifications are appended. H.S.W.

N66-19617*# Case Inst. of Tech., Cleveland, Ohio. Engineering Design Center.

DIGITAL LIQUID LEVEL TRANSDUCER

Fred M. Welsh Jun. 1965 131 p refs

(Grant NsG-36-60)

(NASA-CR-71058; EDC-1-65-33) CFSTI: HC $4.00/MF $1.00 CSCL 14B

A technique for accurate, absolute binary measurement of liquid level by ultrasonic means is developed; and a measurement instrument is designed, fabricated, and evaluated. The digital liquid level transducer differs from the conventional ultrasonic depth indicating system in that two time encoding measurements form the raw data to a limited purpose digital computer which corrects the measurement for sound velocity, density, and temperature changes of the liquid. The second time measurement over a known distance is used to eliminate the velocity of sound from the equation which defines the level of the liquid. The instrument which was logically implemented on an existing pilot-plant, has a resolution of ±0.1% for its 2 ft water depth range over temperatures of 40° to 100°F, and operates at a counting frequency of 4.95 Mc./sec. The extension of the compensated measurement concept to greater depths for the same full range resolution is discussed in detail. Author

N66-19641*# Autonetics, Anaheim, Calif.

APPLICATION OF GYROCOMPASSING TO SPACE MISSIONS Final Technical Report

11 Feb. 1966 481 p refs

(Contract NAS8-20192)

(NASA-CR-71198; C6-332/3061) CFSTI: HC $7.81/MF $2.50 CSCL 17G

Gyrocompassing in general, including both the situations under which it is used and the instrumentation utilized, is considered. Uses are operation at a fixed site on the earth or other planet, and in a moving vehicle on the surface or in free orbital flight. The techniques are classified broadly into two groups: measurement gyrocompassing for determining direct rotation and direction of local vertical, and indirect gyrocompassing utilizing stable inertial platforms. The applications and instrumentations discussed in detail are: sensors, including gyroscopes, accelerometers, horizon sensors, and optical telescopes; indirect gyrocompassing on fixed sight on earth, using gyroscopes only to stablize the platform; direct terrestrial gyrocompassing for prelaunch alignment of accelerometers and gyroscopes for space probes; gyrocompassing at fixed location on other planets; indirect gyrocompassing involving techniques for the orbital gyrocompassing alignment of a gimballed locally level platform; and mechanization techniques for measurement gyrocompassing in orbit. Included also are tables and discussions of errors. N.E.N.

N66-19691*# General Dynamics/Convair, San Diego, Calif.

PRELIMINARY DESIGN STUDY: OXIDIZER TANK HELIUM PRESSURE REGULATOR, FLOX-ATLAS, AIRBORNE Final Report

D. L. Gray, D. E. Howard, and A. M. Colvin 24 Sep. 1965 123 p refs

(Contract NAS3-3245)

(NASA-CR-54878; GD/C-BJB65-008) CFSTI: HC $4.00/MF $1.00 CSCL 14B

Four design approaches were successively pursued for the FLOX Atlas regulator. The first two designs contained unique features which lent themselves to a direct acting regulator. As it became increasingly apparent that some means of amplification would be required, these approaches were abandoned. The third approach contained more sophisticated features which provided the force amplification necessary to achieve the designed accuracy and still maintained the regulators physical size within reasonable parameters. The fourth approach incorporated further improvements over the third, and fulfilled the design requirements. The most important features of the design are as follows: (1) Certain sections, such as the shutoff valve, were taken from existing designs which have been fully developed. (2) For stable operation, a device is incorporated to change the regulation gain when inlet pressure decreases to 2000 psi. (3) The gain change device also accomplishes a programmed pressure change in tank pressure. (4) No dynamic seals are used. (5) Leakage is reduced by assembling the high pressure components from the lower pressure side. (6) All shutoff functions and desired low leakage paths incorporate poppet-type devices. Author

N66-19707# Electro-Mechanical Research, Inc., Sarasota, Fla.

A REDUNDANT LOW POWER PCM TELEMETER FOR THE ORBITING SOLAR OBSERVATORY

George E. Brechling and Paul Beckwith [1965] 20 p Prepared for Ball Bros. Res. Corp.

The Orbiting Solar Observatory satellite requires a PCM telemeter having a very high probability of successful operation for a period of one year. Consideration of the reliability requirements led to the conclusion that the desired reliability can be achieved only by the use of redundancy. Several approaches to redundancy are evaluated in terms of the system requirements. Also, the development of a PCM telemeter system consisting of a basic timing clock for all satellite functions, analog subcommutators, a digital commutator, an analog-to-digital converter and associated parallel-serial converters and modulators is described. Long term reliability is obtained by complete component testing, aging and selection, and by the use of redundancy at the basic component level. Both analog and digital circuits are designed using quad-type redundancy. Further, a new approach to analog circuit redundancy is discussed in detail. A single transistor is replaced by a quad of transistors. The general concept is that two of the transistors in the quad remain saturated while the other two perform actively. Junction shorts occurring in the active transistors cause the saturated transistors to assume the active role, while suitable feedback stabilizes the gain and operating points. E.E.B.

N66-19722# Flying Personnel Research Committee, London (England).

AN APPARATUS FOR THE MEASUREMENT OF CLOTHING INSULATION

J. D. Nelms and J. F. Goodall (Roy. Air Force Inst. of Aviation Med.) Jun. 1964 25 p refs
(FPRC/Memo-206)

An apparatus using the principle of comparison of thermal gradients and calibrated with reference to still air was constructed. Hot and cold water tanks induced thermal gradients across standards of perspex. The apparatus was found to be convenient in use and also proved to be accurate in measurement of emissivity and in separating the conductive, convective and radiative components of heat flow. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-18506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECIFIC FEATURES IN SOLDERING COPPER WITH GALLIUM-BASE SOLDERS
V. L. Grishin and S. V. Lashko 17 Nov. 1965 12 p ref Transl. into ENGLISH from Priborostroyeniye (Moscow), no. 3, 1965 p 23–24
(FTD-TT-65-1024/1+2+4; AD-625145) CFSTI: HC $1.00/MF $0.50

The use of pure gallium as a solder with subsequent heat treatment of the soldered joints at 50 to 605C (Oxidizing atmosphere, vacuum) does not assure a satisfactory strength of the soldered joints, either at room temperature or at high temperature. For obtaining soldered unions with satisfactory strength and high temperature of the unsoldering, a mixture of gallium with very fine powder of copper (30 percent of copper and 70 percent of gallium) is the best. The strength of the soldering and the temperature for the unsoldering are raised with the heating of the soldered joints in a vacuum. Similar heating in the air leads to a lowering of the strength from 6 to 0.5 kg/mm sq. TAB

N66-18514# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE EFFECT OF ADDITIONS TO POLYCAPROLACTAM "B" ON ANTIFRICTION PROPERTIES AND ADHESION TO METAL
D. S. Makhmudov and A. N. Levin 15 Nov. 1965 14 p refs Transl. into ENGLISH from Tr. Inst. Khim, Machinostr. (Moscow), v. 27, 1964 p 194–200
(FTD-TT-65-986/1+2+4; AD-625286) CFSTI: HC $1.00/MF $0.50

It is shown that the addition to polycaprolactum of aluminum powder, talcum, graphite and, in particular, molybdenum disulfide improves its antifriction properties and certain other physio-mechanical qualities. TAB

N66-18519# Ampex Corp., Redwood City, Calif.
INTERACTION BETWEEN SELF-ACTING AND EXTERNALLY PRESSURIZED EFFECTS IN A FOIL BEARING
E. J. Barlow Oct. 1965 24 p refs
(Contract Nonr-3815(00)(X))
(RR-65-12; AD-625762) CFSTI: HC $1.00/MF $0.50

For a foil bearing, the interaction between the flow of lubricant from feed holes and the flow in from the surrounding environment is calculated numerically. The results are applicable for a partial arc foil bearing whenever the feed holes are far from both ends of the wrap angle. The report extends the linearized solution into the nonlinear range. Author (TAB)

N66-18555# Bliley Electric Co., Erie, Pa.
PRODUCTION ENGINEERING MEASURE. CR-(XM-53)/U QUARTZ CRYSTAL UNITS Third Quarterly Report, May–Jul. 1965
J. M. Wolfskill, Merle George, and Robert Mouck Jul. 1965 29 p
(Contract DA-36-039-AMC-03640(E))
(AD-626433) CFSTI: HC $2.00/MF $0.50

During the third period, the development of crystal unit designs was nearly completed. Designs for the crystal resonators themselves were established, and designs for the mounting assemblies were nearly completed. A special claw mounting arrangement was developed; when adapted to the 1-megacycle units, it greatly improved Q levels, but it was not as adaptable to the higher frequencies because of their thinner quartz plates. As a result, it has been found impractical to meet the million-Q goal at frequencies above two megacycles with production-type units. Revised requirements of 0.9-million at 3 Mc, 0.8-milion at 4 Mc, and 0.6-million at 5 Mc have been proposed. The equipment and procedures for conducting the 6-month reliability study have been established and are being checked out by use on experimental units. The arrangement provides practical means of making weekly frequency headings on 1000 units by using special holding jigs to position crystals in precision oilbath temperature controllers and using transistor oscillators which connect directly to terminals on the positioning jigs. Readings are recorded by a digital printer. Author (TAB)

N66-18621# Army Foreign Science and Technology Center, Washington, D. C.
APPLICATION OF HIGH-FREQUENCY HEATING IN THE BONDING OF GLASS-REINFORCED PLASTICS
L. M. Koval'chuk et al Dec. 1965 11 p ref Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 3, 1965
(FSTC-381-T65-606; AD-626066) CFSTI: HC $1.00/MF $0.50

High frequency bonding is economically justified only with mass production. As a general rule, this form of bonding is not recommended for small lot production. Author (TAB)

N66-18642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR SPRAYING FERROMAGNETIC FILMS ON A SUBSTRATE IN A VACUUM

N. I. Spin'kov and V. M. Krasil'nikov 15 Nov. 1965 6 p Transl. into ENGLISH from Russian Patent no. 165629 (Appl. no. 822408/22-2, 21 Feb. 1963) 2 p
(FTD-TT-65-991/1+2+4; AD-625285) CFSTI: HC $1.00/MF $0.50

The object of the invention is a device for spraying ferromagnetic films on sublayers (backing) in a vacuum. To get films that are uniform in thickness and magnetic properties, the sublayers in the cassette or box are arranged vertically on an inner surface of a cylinder rotating around the vaporizer, the axis of which is parallel to the inner magnetic field.
Author (TAB)

N66-18654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE ELASTICITY OF SATURATED VAPORS OF LUBRICATING MATERIALS
V. M. Martynov and M. V. Morozova 3 Dec. 1965 16 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 12, 1963 p 62-65
(FTD-TT-65-1063/1+2+4; AD-625155) CFSTI: HC $1.00/MF $0.50

On the basis of experimental data, obtained during the study of elasticity of saturated oil and grease vapors, it can be concluded, that, if the oil or grease are designated for use within a period of long time in vacuum conditions, when the vapors of evaporating components do not effect the operation of the mechanisms, evaluation of the working period of the given lubricant will be insufficient by the value of the initial vapor elasticity. The initial vapor elasticity depends upon the admixture of light components, the removal of which sharply reduces vapor elasticity.
TAB

N66-18656# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING LUBRICANT FOR TITANIUM PARTS
N. K. Sul'zhenko, V. P. Barannik et al 15 Dec. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 166081 (Appl. no. 819801/23-4, 7 Feb. 1963) 1 p
(FTD-TT-65-1193; AD-625160) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of obtaining a lubricant for titanium parts on the basis of crystalline iodide for preventing the seizing of fastened titanium parts and improving anticorrosion capacity. Oleic acid is subjected to interaction with crystalline iodine at a temperature of 85 degrees in the ratio of 1:1.
Author (TAB)

N66-18688# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
ELECTRON-BEAM TUBE-TO-TUBESHEET WELDING
H. J. Murphy 9 Aug. 1965 33 p ref
(Contract W-31-109-ENG-52)
(KAPL-3110) CFSTI: HC $2.00/MF $0.50

Electron beam welding was investigated for application to the welding of Ni-Cr-Fe Alloy 600 tube-to-tubesheet joints. Equipment of both the low and high voltage type was considered. Metallographic and ultrasonic evaluations were performed. The results showed that Alloy 600 tubes can be electron beam welded to a weld-metal composition tubesheet without the formation of tube or tubesheet fissures, but the joining of Alloy 600 tubes to an Alloy 600 tubesheet may produce intergranular fissuring of the tubesheet. This effect is particulary pronounced in ghost-grained Alloy 600. Porosity, although inherent in partial-penetration electron beam welds, was considered innocuous since any porosity >12 mils in diameter can be located by ultrasonic inspection to ensure a minimum leak path. Ultrasonic inspection can be performed to measure the depth of joint fusion within ~12 mils as well as to locate porosity >12 mils in effective diameter. The limiting problem in the application of electron beam welding to tubesheet joints is one of weld nugget joint alignment.
Author (NSA)

N66-18743# Commissairat a l'Energie Atomique, Saclay, (France). Centre d'Etudes Nucleaires.
COMPARATIVE STUDY OF THE CREEP BEHAVIOR OF SINGLE CRYSTALS AND POLYCRYSTALS OF α URANIUM [ETUDE COMPAREE DU COMPORTEMENT AU FLUAGE DE L'URANIUM ALPHA MONO ET POLYCRISTALLIN]
Jean-Pierre Andre (Ph.D. Thesis) 1965 35 p refs In FRENCH
(CEA-R-2715)

A description is given of the creep machine developed to study the deformation of uranium at high temperature in vacuo with continuous recording. Results are presented concerning the polycrystals of uranium. The application of the DORN method gives an activation energy for creep of 42 ±2 Kc, above 550°C, equal to the activation energy for self-diffusion. The study of the variation of the creep rate with the applied stress and the metallographic observations of the deformation-induced polygonization allow to conclude that the deformation is controlled by climb of dislocations. The deformation above 550°C of single crystals of uranium (obtained by $\beta \rightarrow \alpha$ change) is also studied. The major deformation mode is slip. The preexisting polygonization of these single crystals is very stable and the disorientation between adjacent subgrains increases with the deformation. The activation energy for creep is higher than that for polycrystals. These results show the influence of the polygonization due to the $\beta \rightarrow \alpha$ change on the creep behavior of α uranium.
Author (NSA)

N66-18801# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
SURFACE CRACK DETECTOR
K. J. Krystyan 2 Jul. 1965 14 p
(Contract W-31-109-ENG-52)
(KAPL-M-6484) CFSTI: HC $1.00/MF $0.50

A feasibility experiment to determine whether or not commercially available diamond phonograph styli used in conjunction with strain gages and appropriate readout equipment could be used to detect surface cracks on metals was completed. The results obtained indicate that surface cracks, of the type investigated, approximately 0.0005 to 0.001 inch wide and less than 0.001 inch deep could be detected if the diamond styli passed over them.
Author (NSA)

N66-18825# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
HYDROSTATIC BEARINGS
R. W. Skulski 12 Apr. 1965 11 p Presented at the 3d Ann. Gen. Meeting of IMOG, Lawrence Radiation Lab., Livermore, Calif., 14-17 Apr. 1964
(Contract AT(29-1)-1106)
(CONF-640407-1; RFP-375) CFSTI: HC $1.00/MF $0.50

A survey is presented of the operation and design of hydrostatic bearings. The mechanism of load support is described for a simple flat bearing. Flow restrictors are required when two or more bearings or recesses are supplied from a single pump. The response to load change is considered, and it is shown that the bearing stiffness changes with load. Other bearing configurations and the complications produced by large relative motion between slide and bearing are considered. It is concluded that hydrostatic bearings should be conservatively designed for static conditions. NSA

N66-18857# Bettis Atomic Power Lab., Pittsburgh, Pa.
TEST RIG FOR USE IN WEAR AND FRICTION STUDIES IN A WATER ENVIRONMENT
N. B. Dewees Mar. 1965 39 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-288) CFSTI: HC $2.00/MF $0.50

A test rig is described for measuring the rate of wear and the coefficient of friction for materials tested in a pressurized water environment at temperatures to 500°F. The rig operates with either a continuous sliding or an oscillating motion. Two different designs of specimens are tested simultaneously to show in a single test whether loading or design of specimens may significantly affect test results. Tests can be performed with a unit loading on the wear surfaces of 30 to 9000 psi with the standard specimens. Evaluation of a material combination is based upon relative wear rates between the two types of specimens as well as the magnitude and trend of wear rate and roughness in successive test intervals. Examples are given for material combinations having widely different performance. Author (NSA)

N66-18872# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ELECTROMAGNETIC CIRCULATION PUMP FOR CORROSIVE GASES [POMPE DE CIRCULATION ELECTROMAGNETIQUE POUR GAZ CORROSIFS]
Pierre Noe, Denise Delafosse, and Gérard Deletre Feb. 1965 16 p In FRENCH
(CEA-R-2744)

In order to transport very corrosive products (fluorinated compounds), a totally metallic circulation pump capable of operating at above room temperatures and with a molecular vacuum was developed. Maximum simplicity was the primary aim both in conception and operation. The tests showed that the compression ratios produced, although not high, are interesting (1.5 at a pression of 100 torr). The flow-rate range is very wide: about one hundred ccs/atm/min. to 3,000 ccs/atm/min. Desorption of the pump presents no difficulty if both the aspiration and the reject sides are pumped together. A hole of 2 mm diameter drilled in the piston makes it possible to desorb the space between the two segments. The price of the pump is 1,300 F, with the electrical cabinet. Author (NSA)

N66-18884# Sandia Corp., Albuquerque, N. Mex.
TABLE OF 20,000 GEAR RATIOS 1.0000 TO 3.0000
R. L. Lachance and F. O. Lane Feb. 1965 202 p
(Contract AT(29-1)-789)
(SC-M-65-79) CFSTI: HC $6.00/MF $1.75

A series of twenty thousand ratios was compiled primarily for a filament winding machine with a three-step transmission system. Author (NSA)

N66-18900# Sandia Corp., Albuquerque, N. Mex.
DESIGN PRINCIPLES FOR MOLDED PLASTIC POTTING SHELLS
Edward A. Salazar Feb. 1965 9 p
(Contract AT(29-1)-789)
(SC-DR-64-2135) CFSTI: HC $1.00/MF $0.50

Information is given on the good design in molded plastic potting shells. Some common pitfalls are discussed, and fundamental principles that should be followed for economy and maximum serviceability are described. Author (NSA)

N66-18956# Ghent Univ. (Belgium). Metallurgical and Metallographical Lab.
THE RUSTPROOF PLATING OF HEAVY-GAGE STEELS Quarterly Report No. 2, Oct. 1-Dec. 31, 1964
N. V. Neratoom and S. A. Soudometal 18 Jan. 1965 11 p Transl. into ENGLISH from French
(Contract EURATOM-008-63-12 TEEB)
(EUR-2093; EURAEC-1296) CFSTI: HC $1.00/MF $0.50

Progress is reported on the process development for welding stainless steel tapes on a Soudotenax 56 steel base. NSA

N66-19008# College of Aeronautics, Cranfield (England).
MINIMUM HYDRODYNAMIC OILFILM THICKNESS: AN EXPERIMENT AND THEORETICAL INVESTIGATION
B. R. Reason Aug. 1965 23 p refs
(CoA-AERO-184) CFSTI: HC $1.00/MF $0.50

The paper deals with an experimental and analytical investigation of the lowest limit of hydrodynamic film thickness compatible with the condition of 'running in'. Using the working geometry of an experimental test rig together with the two dimensional Reynolds equation, an analytical expression for the minimum hydrodynamic film thickness has been developed. The problem has been investigated from an experimental standpoint using a measuring system based on an air gauge and capable of detecting film thickness changes of the order of 10^{-6} inches. Although calculations of the magnitude of the minimum hydrodynamic oilfilm thickness gave values as low as 5×10^{-6} inches, the minimum value obtained experimentally was 2.5×10^{-5} inches. Author

N66-19031*# Aerojet-General Corp., Sacramento, Calif.
DEVELOPMENT OF LIQUID OXYGEN COOLED 110 MM ROLLER AND TANDEM BALL BEARINGS AT UP TO .5 $\times10^6$ DN VALUES FOR THE OXIDIZER TURBOPUMP OF THE M-1 ENGINE Technology Report
M. W. Young and L. F. Kirby 11 Mar. 1966 88 p refs
(Contract NAS3-2555)
(NASA-CR-54816; AGC-8800-23) CFSTI: HC $3.00/MF $0.75
CSCL 13I

A development program for the purpose of evaluating the suitability of the bearing package designed for the M-1 liquid oxygen turbopump was completed. The test results indicate that the bearing performance is adequate as compared with that predicted during the design phase. The 110 mm roller and tandem ball bearings were demonstrated at $.5\times10^6$ DN values, radial loads of 15,000 lb and thrust loads up to 70,000 lb (twice the rated load). Liquid oxygen and liquid nitrogen were used as coolants; bearing materials were 440C stainless steel with armalon cages. Author

N66-19065 Joint Publications Research Service, Washington, D. C.

THE DESIGN OF ROD TYPE TORSION DRILLS USING CONFORMAL MAPPING PROGRAMMING

N. V. Alekseyev and L. N. Ivanenro *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 163–168 refs (See N66-19046 09-08) CFSTI: $6.00

The approximate method of conformal mapping, based on trigonometric interpolation, is applied to the design of rod type torsion drills. The method permits finding of a function which maps a unit circle on a given region in the form of a power series $Z=\sum_{n=1}^{\infty} C_n \zeta^n$, where $C_n=a_n+ib_n$ for any accuracy given in advance. In this case, the mapping of a unit circle on a region close to the transverse cross section of the drill is fully realizable and ensures accurate solution of the torsion problem for the mapped region. A series of experiments were conducted on a calculator with respect to a universal program which uses the method of P. F. Fil'chakov. Solutions were obtained for a significant number of examples which include various versions of the transverse cross sections of the drills. Both standard drills and new geometry drills were investigated with reinforced cores. R.N.A.

N66-19067 Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF OPTIMAL CUTTING OF MATERIALS

V. L. Rvachev and Yu. G. Stoyan *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 178–188 refs (See N66-19046 09-08) CFSTI: $6.00

This paper is concerned with the application of R-functions to the problem of optimal cutting of materials with minimum waste. It is assumed that the material which is subjected to cutting is isotropic. The problem involves construction of a system of inequalities which must be satisfied by placement parameters of the patterns so that no mutual superposition of patterns occurs, and so that all patterns will be arranged on the material which is being cut. Each placement of the patterns which satisfies these two conditions is called a cut. In each specific problem there is a set of possible cuts. The problem of optimal cutting consists of selecting the optimal cut from this set. R.N.A.

N66-19166*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

VALVE WITH BALL SEAT SPRING AND ANTIFLUTTER BAFFLE

William F. MacGlashan, Jr. 27 Jul. 1962 10 p *Its* Invention Rept. No. 30-140

(Contract NAS7-100)

(NASA-CR-70367) CFSTI: HC $1.00/MF $0.50 CSCL 13K

A baffle plate and star spring arrangement was used in a ball check valve, designed for high flow conditions, to prevent flutter impact and squeal damage. The star spring consists of a ball centered flange with integral radial fingers resting on the ball cavity innerface. Any tendency of the ball to flutter is damped by the friction of the fingers on the innerface. The baffle is used to direct the flow around the spring fingers in cases where the dynamic pressure would be great enough to damage the spring. Drawings are included. D.T.

N66-19169*# Republic Aviation Corp., Farmingdale, N. Y.

DEVELOPMENT OF TECHNOLOGY FOR HOT DRAPE FORMING AND NOZZLES FOR TORUS SECTIONS Final Report, Jun. 1963–Dec. 1965

G. Bohmann, F. J. Hoppe, W. Matlach, and W. B. Trepel 31 Dec. 1965 126 p

(Contract NAS8-11527)

(NASA-CR-70870; FHR-3196) CFSTI: HC $4.00/MF $1.00 CSCL 13H

The design and manufacture of self-contained ceramic tools for hot drape forming of torus tank gore segments, and for forming of flared port openings in these segments are described, along with operation and control techniques. The ceramic die was constructed of heavy welded steel base with a surface of fused silica cast glasrock cement and backed by shaped, dense glasrock foam blocks. The 7039 aluminum base alloy segments were formed, and the yield strength, tensile strength, elongation, and hardness data are given for 21 segments. It was also found that titanium base alloys could be formed. In addition a technique of hot forming flared port openings which offer a minimum of resistance to fluid flow and a continuous surface amenable for welding attaching conduits was developed. It is concluded that the hot drape forming method performed well and is particularly applicable to the forming and heat treatment of large complex configured parts. N.E.N.

N66-19192# Mechanical Technology, Inc., Latham, N. Y.

FRICTION AND LUBRICATION AT EXTREME PRESSURES Interim Report

M. B. Peterson and F. F. Ling 2 Dec. 1965 67 p refs

(Contract Now-65-0363-c)

(MTI-65TR59)

A theoretical and experimental program is being conducted to better define the frictional process in hot metal deformation. The initial portion of this program was directed toward gaining a better understanding of friction at the extreme pressures characteristic of metal working. To do this a simple bench test was used. A foil of metal (workpiece) is compressed between an anvil and a flat plate. When a force is applied to the anvil, slip takes place between the metal and the flat. Using this device, the coefficient of friction was determined for pure metals for pressures to 200,000 psi and temperatures to 1000° F. Three regions of friction were found: classical friction; deformation friction, where the friction is completely defined by plastic deformation; and thin film friction, in which shear rate effects are hypothesized. An analysis was made of two modes of deformation and compared with experimental results. A study of pure metal lubrication was conducted. It is proposed that the effectiveness of a lubricant for a given metal can be based upon its ability to withstand the wear of the deforming metal. Author

N66-19198*# General Electric Co., Schenectady, N. Y. Research and Development Center.

RESEARCH AND DEVELOPMENT ON ELECTRODEPOSITED INORGANIC SEPARATORS Second Quarterly Report, 15 Jul.–15 Oct. 1965

[1965] 24 p

(Contract NAS5-9168)

(NASA-CR-70374) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Work was continued on studying the effect of processing parameters on deposition rate and film properties as well as conducting preliminary tests with cells to determine the effect of sterilizing coated electrodes at 145°C. Studies showed that over the range of current densities investigated (200–100 ma/in.^{2}) the calcium hydroxide films are more adherent and uniform than the magnesium hydroxide films when using an electrolyte concentration of 70 g/l of the respective acetates for coating. Improvements in the uniformity and adherence of magnesium hydroxide films were obtained by increasing the

magnesium acetate concentration to approximately 450 g/l. Sterilization tests on calcium hydroxide coated silver electrodes show that the electrodes can be sterilized for at least two periods of 40 hours at 145°C without significant loss of coating. Charge–discharge cycling tests after sterilization show that some electrodes develop their nominal capacity in three to four cycles when charged at c/5 rates and discharged at c/2.5 rates. Unsterilized coated electrodes developed their nominal capacity within two to three cycles.
Author

N66-19206# Bureau of Naval Weapons, Washington, D. C.
HANDBOOK: RELIABILITY ENGINEERING
1 Jun. 1964 379 p refs
(NAVWEPS-00-65-502) GPO: $2.75

This handbook provides step by step procedures for the definition, pursuit, and acquisition of required reliability and maintainability in naval weapons systems, equipment, and components. The methods presented are generally applicable to all categories of weapons system elements—electronic, electro-mechanical, mechanical, hydraulic, chemical, etc. It gives general guidance for the implementation of selected reliability program functions, as well as procedures and technical detail sufficient for design guidance in the actual achievement of required programs. The handbook attempts to satisfy the need for a digest of these principles through practical examples drawn from the several phases of a typical system life cycle. Charts and diagrams illustrate the text. H.S.W.

N66-19249# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESULTS OF TESTING THE STAGES OF CENTRIFUGAL PUMPS WITH VARIOUS FLOW TWISTS AT THE INPUT INTO THE WHEEL
V. M. Shlindman 1 Dec. 1965 17 p refs Transl. into ENGLISH from Energomashinostroenie (Moscow), no. 11, 1964 p 14–17
(FTD-TT-65-1027/1+2+4; AD-625291) CFSTI: HC $1.00/MF $0.50

Results are given of analyzing experimental characteristics on the basis of determining the input circulation by the difference of stage pressures during the work with and without stream twist in front of the wheel. Author (TAB)

N66-19263# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATING THE INTERDEPENDENCE OF MACHINE SUBASSEMBLIES IN DETERMINING RELIABILITY
E. G. Vol'pert 3 Dec. 1965 8 p refs Transl. into ENGLISH from Standartizatsiya (Moscow), no. 7, 1964 p 14–16
(FTD-TT-65-1054/1+4; AD-625301) CFSTI: HC $1.00/MF $0.50

Methods of calculating the reliability of parts from component elements are reviewed, based on the assumption of mutual independence of failures of elements in operation. It is indicated that this premise is frequently not justified in machine construction. In fact, a disbalance of the shaft of one interlinked subassembly can substantially decrease the service life of the bearing in another subassembly, and the creation of additional support when a console shaft of one subassembly is attached to another can increase the service life of the parts of the first subassembly. It is shown that to obtain the necessary data for calculating reliability, it is necessary to test the subassemblies both separately and in the assembly. The correlation coefficients must be found from the data, and the distribution functions for the separate subassemblies must be selected. In addition, the reliability indices of the whole group of subassemblies must be simultaneously determined. It is pointed out that the multidimensional distribution function can be found from the distribution functions of the separate subassemblies, and the obtained data can then be statistically evaluated. R.R.D.

N66-19368# Automation Industries, Inc., Boulder, Colo. Research Div.
ADVANCEMENT OF ULTRASONIC TECHNIQUES USING RERADIATED SOUND ENERGIES FOR NONDESTRUCTIVE EVALUATION OF WELDMENTS Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1965
B. T. Cross, G. L. Cross, and G. J. Posakony 15 Jan. 1966 22 p
(Contract NObs-92530)
(TR-66-3; AD-627231) CFSTI: HC $1.00/MF $0.50

The long range objective of the work being performed under this contract is to find a better technique for ultrasonic nondestructive evaluation of weldments. The immediate objective is to provide a clearer understanding of the ultrasonic weld inspection technique known as the 'Delta Configuration'. This technique has been employed for several years, but the approach has been entirely empirical. Before further advances could be made, analytical verification of the physics of the sound energy had to be established. Once the path and pattern of the sound energy can be predicted, instrumentation and fixturing can be developed which will amplify the merits of this technique. A test block, designed to study the phenomena, was used to obtain field intensity maps of the sound energy. The tests provided an unexpected result in that a second energy conversion was identified. The existence of this second mode conversion was verified. Knowledge obtained is important because it increases the potential of using the Delta Configuration for both thick and thin weldments. Author (TAB)

N66-19381# Mechanical Technology, Inc., Latham, N. Y.
STRESSES IN LUBRICATED ROLLERS CONSIDERING ARBITRARILY DISTRIBUTED NORMAL AND TANGENTIAL LOADS
H. S. Cheng and R. J. Wernick Dec. 1965 28 p refs
(Contract Nonr-3279(00))
(MTI-65TR61; AD-626008) CFSTI: HC $2.00/MF $0.50

A numerical solution to the stresses in lubricated rollers considering arbitrarily distributed normal and tangential loads is obtained. Results are obtained for rollers operating in the elastohydrodynamic regime with and without sliding. The effect of a small amount of slip in the contact is shown to be significant. Author (TAB)

N66-19429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF BONDING POLYAMIDES TO METALS
E. A. Mayorova and T. V. Ovchinnikova 25 Oct. 1965 5 p Transl. into ENGLISH from Russian Patent no. 167625 (Appl. no. 841008/23-5, 31 May 1963) 1 p
(FTD-TT-65-796/1+4; AD-625228) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of gluing polyamides to metals with the aid of an epoxy glue. To improve the strength of the bond of the polyamides with metals, the surface of the polyamides to be glued is first covered with a furfuryl lacquer. Author (TAB)

N66-19456*# General Dynamics/Convair, San Diego, Calif.
DETECTION OF CRACKS ADJACENT TO SPOTWELDS BY RADIOGRAPHY IN THIN STAINLESS STEEL SHEET
Charles J. Kropp and L. D. Girton 29 Jan. 1962 19 p
(NASA-CR-54540; MRG-289) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Radiographs were made of two multispot circumferential joint specimens that had been cyclically loaded until cracks formed, ranging in depth from 2 to 100% of the sheet thickness. In a radiograph made using an X-ray tube with a standard glass window, cracks could be detected that were greater in depth than 23% of the sheet thickness (.013"). Using an X-ray tube with a beryllium window, cracks could be detected that were greater in depth than 15% of the sheet thickness (.010"). For thin sheet stainless steel it was recommended that a beryllium windowed X-ray tube be used because the radiographs could be read with greater facility and cracks of shorter depth could be detected. Author

N66-19474# Socony Mobil Oil Co., Paulsboro, N. J.
STUDY AND EVALUATION OF THE OXIDATIVE AND DEPOSIT-FORMING PROPERTIES OF HIGH TEMPERATURE LUBRICANTS
S. J. Leonardi and E. A. Oberright Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1965 26 p refs
(Contract AF 33(615)-1367)
(AFAPL-TR-65-85; AD-625833) CFSTI: HC $2.00/MF $0.50

A series of high temperature oils was evaluated in a high temperature thin film oxidation unit. The apparatus measures oxygen consumption and deposits formed by the oils in thin films on a rotating heated disk. The test exhibited excellent correlation with deposit formation in a jet engine. To simplify the selection of conditions for future testing requirements, the effects of several test variables were evaluated. These include test time, oil circulation rate, oxidation of the sump oil, dispersion of the sump air, and effects of metals in the sump. Author (TAB)

N66-19514*# Stone (Ralph) and Co., Inc., Los Angeles, Calif.
DESIGN STUDIES AND PROTOTYPE FABRICATION OF LUNAR SAMPLE CONTAINERS
Dec. 1965 139 p refs
(Contract NAS9-4338)
(NASA-CR-65241) CFSTI: HC $4.00/MF $1.00 CSCL 13D

Detailed evaluations were completed on structural and fabrication techniques, cover and latching systems, handle configurations and seal designs, as well as a review and design study of the sample protection system, inner containers, and a bag dispensing system. In addition, two prototypes were fabricated for testing and evaluation of various design concepts. Sample container designs call for a vacuum sealed stainless steel honeycomb parallelepiped, 7 1/4 by 11 by 18 3/4 in. having a full opening 11 by 18 3/4 in. lid. The box is opened by drawing a cable through a ductile nickel membrane seal. The return to earth seal is a zero leakage indium solder design. Inside of the box are open topped canisters which either can be removed as required to accommodate any desired sample configuration, or can be used as smaller package containers. Plans are also reported for a gas sampling device and a protobiological sampling device to obtain samples from 6 to 18 in. beneath the lunar surface. Test criteria, test results, and special analyses are included. D.T.

N66-19564# Southwest Research Inst., San Antonio, Tex.
LUBRICATION RESEARCH FOR AERO PROPULSION SYSTEMS Phase Report No. 1, Feb. 1-Sep. 1, 1965
E. L. Anderson, B. B. Baker, and P. M. Ku Oct 1965 42 p
(Contract AF 33(615)-2384)
(AFAPL-TR-65-118; AD-625485) CFSTI: HC $2.00/MF $0.50

Investigations were conducted to determine the possible effect of selected aircraft gas turbine engine lubricants and various solvents on the removal of carbonaceous deposits which had accumulated during service on the No. 2 bearing rear support of the J-57 engine. Six MIL-L-7808 type and one MIL-L-23699 type lubricants and six solvents were included in this program. Under the test procedures used, the deposits on the bearing support specimens were found to be quite stable in the presence of all seven lubricants investigated; no loosening or sloughing of the deposits was observed. Of the six solvents evaluated, only Cities Service 26 was found to be effective in removing significant amounts of deposits from the specimen. Flashing of liquid water, loosened crinkled, blistered, and flaked deposits but had no effect on smooth carbon or varnish. Author (TAB)

N66-19598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS INGESTION AND SEALING CAPACITY OF HELICAL GROOVE FLUID FILM SEAL (VISCOSEAL) USING SODIUM AND WATER AS SEALED FLUIDS
Lawrence P. Ludwig, Thomas N. Strom, and Gordon P. Allen Washington, NASA, Mar. 1966 26 p refs
(NASA-TN-D-3348) CFSTI: HC $2.00/MF $0.50 CSCL 11A

An experimental investigation was conducted on gas ingestion and sealing capacity (expressed as a dimensionless sealing parameter, λG) of viscoseals using water and liquid sodium as the sealed fluids. The investigation covered a Reynolds number range of 2,100 to 60,500. Results disclosed that a helically grooved rotor viscoseal (smooth bore housing) has increasing gas ingestion rates with increasing Reynolds number when the viscoseal liquid interface becomes unstable. Helically grooved housing viscoseals (smooth rotors) showed no gas ingestion when sealing sodium (Reynolds numbers from 10,400 to 37,200); when sealing water, gas ingestion occurred only within a specific range of Reynolds numbers (2,300 to 8,400). Secondary grooves on viscoseal land areas improved sealing capacity and reduced power absorption. Sodium was sealed at 149° to 329°C (300° to 625°F) without measurable liquid loss for operational periods up to 8 hours. Author

N66-19614*# Mechanical Technology, Inc., Latham, N. Y.
EXPERIMENTS ON AN ULTRA-STABLE GAS JOURNAL BEARING
S. B. Malanoski Nov. 1965 40 p refs Prepared for NASA
(Contract Nonr-3730(00))
(NASA-CR-70933; MTI-65TR37) CFSTI: HC $2.00/MF $0.50 CSCL 13I

Shallow grooving in a herringbone pattern has been proposed to enhance the stability of both gas and liquid lubricated journal bearings. It has been shown theoretically that this possibility is particularly advantageous for unloaded journal bearings. Corroborating experiments included the running of an unloaded bearing up to speeds of 60,000 rpm and the collection of steady state load-displacement attitude angle data at intermediate speeds up to and including 60,000 rpm. No sign of bearing whirl instability was detected. There was good correlation between theoretical and experimental data. Design data are included as a guide for future designs. Author

N66-19621*# Martin Co., Denver, Colo.
ANALYTICAL AND STATISTICAL STUDY ON THE EFFECTS OF POROSITY LEVEL ON WELD JOINT PERFORMANCE Progress Report
John F. Rudy 18 Feb. 1965 7 p
(Contract NAS8-11335)
(NASA-CR-71053) CFSTI: HC $1.00/MF $0.50 CSCL 13H

The correlation between porosity defects and the mechanical behavior of a weld is studied. The initial task was to find a means of producing defects with sufficient predictability and consistency of occurrence to allow a statistically planned and efficient program to be conducted. It was of prime importance that the influence which is measured reflects the defect itself, rather than the means to produce the defect. Contaminants were introduced to weld beads by contaminating the surface of the weld filler wire, or by contaminating the shield gas which surrounds the electrode. Seven techniques were studied in the former method, but did not give sufficient porosity in the downhand welding position to enable a broad range defect study. The latter method proved to be more successful in providing a controlled and predictable level of porosity. Background information has been assimilated, and the controlled statistical program has begun. H.S.W.

N66-19622# Franklin Inst., Philadelphia, Pa. Research Labs.
AEROSTATIC [EXTERNALLY-PRESSURIZED GAS LUBRICATED] THRUST BEARINGS
Erwin Loch (Ph.D. Thesis—Graz Univ.) Dec. 1965 193 p refs Sponsored by NASA Transl. into ENGLISH from German
(Contract Nonr-2342(00))
(NASA-CR-71054; T-A2049-26) CFSTI: HC $5.00/MF $1.25 CSCL 13I

The static and dynamic characteristics of single and double acting thrust bearings of many geometrical forms are presented. An equation of general applicability for small disc clearances for radial equilibrium of the compressible clearance flow is derived. The heat transfer of a flowing gas between two discs in close vicinity to each other was found to be very good and, under certain conditions, the clearance flow was subject to an isothermal change of state. All calculations and investigations were extended to bearings in which the flow is in two directions—inward and outward. The optimization and economical calculations of the bearings are discussed. The minimization of the total power input for an externally pressurized bearing yielded optimum values for the compensating space and height of the clearance. Experimental results of heating of the bearing, bearing characteristics, pressure profile in the clearance, and load capacity in the specially designed testing equipment confirm the correctness of theoretical derivations. Axial vibrations can appear, and the possibilities of removing the instabilities are discussed. H.S.W.

N66-19670*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
MAGNETIC WIRE STRIPPING AND CONNECTION METHOD EVALUATION Final Report, 15 Jun.–11 Dec. 1965
F. Z. Keister 6 Dec. 1965 100 p Prepared for JPL
(Contract JPL-K5-330257)
(NASA-CR-70721) CFSTI: HC $3.00/MF $0.75 CSCL 13H

The purpose of this investigation was to perform certain tests involving a variety of magnet wire types, sizes, and joining methods with the end goal being to accumulate sufficient test data to establish a preferred technique or techniques for stripping insulation from fine magnet wires and for connecting these fine magnet wires to heavier nickel wires. This evaluation included the preparation and testing of 1485 specimens (each specimen consisting of two interconnections) using the following materials and techniques: (1) three sizes of copper magnet wire (#42 AWG, #46 AWG, and #50 AWG); (2) three types of heavy wire insulation (Formvar, Isonel, and ML); (3) two wire stripping methods (chemical and mechanical stripping); and (4) four joining techniques (manual soft soldering, fusing in a torch flame, soft solder pot dipping at 1000°F, and silver solder pot dipping at 1200°F). Testing of the magnetic wire specimens included: (1) electrical resistance before and after humidity exposure and temperature cycling; (2) tensile testing before and after humidity exposure and temperature cycling; and (3) visual examination under 20X magnification before and after humidity exposure and temperature cycling. Author

N66-19673# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
BIBLIOGRAPHY OF FACTORY TECHNOLOGY [LITERATUUROVERZICHT WERKPLAATSTECHNIEK]
Jan. 1966 32 p refs In DUTCH, GERMAN, ENGLISH, and FRENCH *Its* Vol. 11, Pt. 1
(W-94) CFSTI: HC $2.00/MF $0.50

This bibliography on industrial technology contains brief summaries on: (1) factory management and production engineering; (2) measurements and controls in production processes; (3) overall reliability aspects of machine tooling; (4) technology of drilling and abrasion; (5) electrochemical grinding, shaped-electrode machining and twinning; (6) welding and forming processes; and (7) production and economic considerations in industrial metal working operations.
Transl. by G.G.

N66-19689*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.
ANALYSIS OF THE M-1 LIQUID HYDROGEN TURBOPUMP SHAFT CRITICAL WHIRLING SPEED AND BEARING LOADS
L. K. Severud and H. G. Reeser 20 Dec. 1965 102 p refs
(Contract NAS3-2555)
(NASA-CR-54825; AGC-8800-28) CFSTI: HC $4.00/MF $0.75 CSCL 13K

The shaft whirling critical speeds for the M-1 fuel turbopump assembly are presented in this report. The roller bearing loads caused by shaft whirling and other sources are also discussed. The predicted critical speeds are 16,000 rpm for the Model I turbopump, 15,700 rpm for the Model II turbopump with an interim inducer, and 18,000 rpm for the Model II turbopump with the final inducer. Nominal operating speeds for the Model I and Model II turbopumps are 11,700 rpm and 13,225 rpm, respectively. Author

N66-19693*# General Dynamics/Convair, San Diego, Calif.
PRELIMINARY DESIGN STUDY: OXIDIZER TANK RELIEF VALVE, FLOX-ATLAS AIRBORNE Final Report
D. L. Gray, C. W. Aulgur, and A. M. Colvin 21 Sep. 1965 99 p refs
(Contract NAS3-3245)
(NASA-CR-54876; GD/C-BJB65-009) CFSTI: HC $3.00/MF $0.75 CSCL 13K

Two separate design philosophies for protecting the FLOX-Atlas oxidizer tank against overpressurization were studied. One approach, the use of the boiloff valve for venting at a high pressure, was abandoned when extensive modifications became apparent. The second system of adding a smaller (2 3/4 line size) valve for relief at maximum tank pressure proved to be more acceptable. Three different designs were studied and one was recommended for use. Author

N66-19766# Pennsylvania State Univ., University Park. Dept. of Industrial Engineering.
SOURCES AND CONTROL OF MECHANICAL VIBRATIONS AFFECTING MACHINE TOOL PERFORMANCE QUALITY
A. O. Schmidt, Inyong Ham, and A. D. Brickman Rock Island Arsenal, Ill., Sep. 1965 288 p refs
(Contract DA-11-070-AMC-628(w))
(RIA-TR-65-2532; AD-625872) CFSTI: HC $6.00/MF $1.25

An investigation of the internal and external sources of vibration in machining operations which impair the performance quality of conventional machine tools was conducted. Particular attention was given to the surface finish of workpieces and the deflection of specific machine tool components. A literature survey on machine tool vibrations was abstracted. All experimental work was carried out under such operating conditions as can be found in an average precision machine shop. The measuring instruments used were standard items except in the case of a special surface analyzer. Sources of mechanical vibrations in machine tools can be determined satisfactorily with limited instrumentation but a thorough understanding of machine tool functions and metal cutting technology is necessary. Forced and self-excited vibrations can occur simultaneously with both having a detrimental effect upon surface finish and dimensions. Author (TAB)

N66-19769# Rock Island Arsenal Lab., Ill. Research and Engineering Div.
RHEOLOGICAL PROPERTIES OF GREASES OVER WIDE TEMPERATURE RANGES Technical Report
Robert L. Young Oct. 1965 33 p refs
(RIA-TR-65-2812; AD-625136) CFSTI: HC $2.00/MF $0.50

Routine physical characteristics were determined for ten lubricating greases of varying types. The roll stability test for lubricating grease, ASTM D1831-64, was performed on each grease at eleven temperatures ranging from −65° to 250°F and for extended periods of time. The apparent viscosity, ASTM D1092-62, was determined for each grease at the same temperatures. Curves were constructed from the roll stability, apparent viscosity and yield stress data. A departure from the general trend of the slope of these curves was taken as a possible phase change or transition temperature. The wear preventive characteristics of lubricating grease, ASTM D2266-64T were determined for two greases that gave indications of having definite phase changes. Wear tests were made over the working range of temperatures for each grease. The results did not show any noticeable change in lubricity of the grease occasioned by the indicated phase change. Author (TAB)

N66-19772# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTIWEAR ADDITIVE FOR LUBRICATING OILS
L. M. Kogan, A. M. Pavikovich, Yu. N. Bezobrazov, and N. M. Burmakin 21 Oct. 1965 6 p Transl. into ENGLISH from Russian Patent no. 166436 (Appl. no. 776560/23-5, 29 Apr. 1962) 2 p
(FTD-TT-65-795/1+2+4; AD-625053) CFSTI: HC $1.00/MF $0.50

The object of the invention is the application of hexachlorcyclopentadiene as an antiwear additive to lubricating oils. Author (TAB)

N66-19782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF WELDING BY THE FUSING OF BETA-TITANIUM ALLOYS
M. V. Poplavko-Mikhaylov, L. G. Strizhevskaya, and L. L. Starova 8 Dec. 1965 4 p Transl. into ENGLISH from Russian Patent no. 167589 (Appl. no. 782795/25-8, 14 Jun. 1962) 1 p
(FTD-TT-65-1159/1+4; AD-625069) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of welding by the fusing of beta-titanium alloys with copper, iron, aluminum and their alloys. To improve the quality of the welded union, the welding is done after previous fusing on the beta-titanium alloy object a layer of metal corresponding to the metal of the second object to be welded. Author (TAB)

N66-19783# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF AUTOMATIC WELDING OF STATIONARY OBJECTS WITH CLOSED LINEAR JOINTS
N. Ya. Kochanovskiy, Ye. S. Feder, and S. M. Katler 8 Dec. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 166981 (Appl. no. 611412/25, 10 Nov. 1958) 2 p
(FTD-TT-65-1158/1+2+4; AD-625068) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of automatic welding of immovable objects with a closed line of the seam, for example the nonrotary joints of tubes, with the aid of the electric arc burning between the parts of the object to be welded and shifted along the line of the seam. For the purpose of eliminating moving parts in the welding unit and assuring a uniform heating of the edges the shifting of the arc, including its anode and cathode spots, is accomplished by an immovable magnetic field produced in the zone of the shifting of the arc. The method may be modified by producing the welding arc between the objects to be welded and an auxiliary immovable nonfusible electrode which has the configuration of the outline (contour) to be welded. Nonfusible electrodes may be used one of which envelopes the object and the other placed inside. TAB

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-19360# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTS WITH GAS LASERS
N. I. Kaliteyevskiy, A. N. Razumovskiy et al 3 Jan. 1966 17 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ., Ser. Fiz. i Khim. (Leningrad), no. 10, 1964 p 40-46
(FTD-TT-65-1060/1+2+4; AD-626955) CFSTI: HC $1.00/MF $0.50

This report explains experiments in the creation and investigation of a laser from an He-Ne mixture, generating in close infrared space (λ-1.15 micr) on one of the transitions between 2s and 2p neon levels. TAB

N66-19516*# Radio Corp. of America, Camden, N. J.
SOLAR-PUMPED LASER Final Report
J. Bordogna, W. Hannan, C. Reno, and R. Tarzaiski Nov. 1965 238 p refs
(Contract NAS9-3671)
(NASA-CR-65242) CFSTI: HC $6.00/MF $1.25 CSCL 20E

The objective of this program was to fabricate a laboratory model of a solar-pumped modulated laser with which technical assessment of an optimum system could be made. The ultimate goal is the transmission of real time television data over ranges of 50 million miles. Results of this program indicate that the capability of a solar-pumped modulated laser to generate high power coherent radiation at optical wavelengths and its inherent advantages of small size and weight recommend it for spacecraft application. Experimental apparatus used in testing solar-pumped modulated lasers, experimental results of successful transmission of real time television pictures, and tradeoffs for space communication systems are given. It is shown that for the desired information bandwidths, a communication range of 50 million miles requires narrow beamwidths, necessitating extensions in the state of the art in beam collimation and tracking. Author

N66-19540*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
USE OF A LASER FOR SATELLITE-RANGE MEASUREMENTS
P. H. Anderson, C. G. Lehr, and L. A. Maestre 3 Dec. 1965 32 p refs Revised
(Grant NsG-87)
(NASA-CR-71099; SAO Special Rept.-190-R) CFSTI: HC $2.00/MF $0.50 CSCL 20E

The development of a laser satellite ranging system is reported. Range measurements have been obtained on retroreflector equipped satellites. Author

N66-19543# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LASER
M. S. Soskin, V. L. Broude, and N. F. Prokopyuk 27 Oct. 1965 6 p Transl. into ENGLISH from Russian Patent no. 164325 (Appl. no. 828515/26-25, 1 Mar. 1963) 2 p
(FTD-TT-65-805/1+2+4; AD-625796) CFSTI: HC $1.00/MF $0.50

A laser which contains a sequential arrangement of a flat mirror, and a second mirror between which there is mounted a rotable prism. The purpose of the rotatable prism is to rearrange the frequency without readjusting the optical system between the active substance and the second mirror. TAB

N66-19545# Korad Corp., Santa Monica, Calif.
LASER-PUMPED LASER Semiannual Technical Summary Report
R. H. Hoskins, O. M. Cernichiari, B. Mc Farland, R. C. Pastor, and B. H. Soffer 15 Nov. 1965 26 p refs
(Contract Nonr-4877(00); ARPA Order NR015-625; Proj. Defender)
(AD-625338) CFSTI: HC $2.00/MF $0.50

Two approaches are being followed: search for a suitable material for pumping with 6943 Å ruby laser radiation and study of known materials pumped with 3472 Å second harmonic ruby laser radiation. This report presents progress on the use of metal-free phthalocyanine for the first approach and quinine sulphate for the second. Potential sources of trouble are analyzed. Author (TAB)

N66-19615*# Hughes Aircraft Co., Fullerton, Calif.
LASER WELDING OF COATED MAGNET WIRE Final Report
J. R. Shackleton and L. J. Martin 17 Nov. 1965 41 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-70935; FR-65-10-257) CFSTI: HC $2.00/MF $0.50 CSCL 20E

Techniques are described for performing laser welds of polythermaleze coated magnet wire to stainless steel and gold plated nickel terminals without using conventional methods for stripping the magnet wire. Good high strength welds were made between the desired terminal materials. Low strength welds could be detected visually by the necking down of the wire adjacent to the weld. It was reported that necking down of the wire was caused by variations in heat input into the weld, as excessive heat causes excessive fusion and necking down. More precise laser control is necessary when working with finer wire. By rejecting welds showing a neckdown of the wire, and precisely controlling the laser so that excess fusion and necking down do not occur, consistently high strength welds can be obtained. Tables and comments on the data accumulated are appended. H.S.W.

N66-19703# Naval Ordnance Test Station, China Lake, Calif.
GaAs INJECTION LASER INVESTIGATION Technical Progress Report No. 377
Donald G. Mc Cauley Oct. 1965 60 p refs
(NOTS-TP-3655; AD-624935) CFSTI: HC $3.00/MF $0.75

This is one in a series of reports to be published on laser technique and application studies. It documents an investigation in which coherent light emission was obtained from a General-Electric Company GaAs p-n junction injection laser. With current densities in excess of 2,400 amp/sq cm, increased external quantum efficiency, spectral line narrowing, and a high degree of primary source coherence of the radiation were shown. The spectral distribution, which is highly dependent on the current-induced changes in the junction temperature during a single injection pulse, was recorded photographically using a new application of the pulsed-intensity oscilloscope technique. Infrared sheet film was exposed to the radiation below, near, and far above threshold resulting in no, a few, and a great many interference fringes, respectively. There is up to 50% error in the quantitative data presented here, which is not unusual for injection laser investigations; however, the qualitative trends toward spectral line narrowing and high external quantum efficiency support the argument for the optical pumping of neodymium glass and calcium fluoride lasers. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-18493# Bureau of Yards and Docks, Pearl Harbor, Hawaii. Pacific Div.

THE OCCURRENCE AND PREVENTION OF CORROSION

Willard E. Edwards Dec. 1965 11 p

(AD-625900) CFSTI: HC $1.00/MF $0.50

The best time to provide protection against corrosion is during the planning, design, and construction stages. This is done through the proper choice of both materials and construction methods. Coatings and cathodic protection of steel may then be called for and used as required. After that, rigid maintenance practices, regularly performed by qualified personnel, are essential in order to realize the great savings which can be accomplished through corrosion mitigation. Whenever underground leaks occur in iron or steel pipes due to external corrosion, it is good insurance to install a magnesium anode at the same time that the leak is repaired. Cathodic protection will usually save many times its installation cost wherever it may be required in corrosive soils or water. TAB

N66-18520# Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.

FRACTURE TOUGHNESS, FATIGUE-CRACK PROPAGATION AND CORROSION CHARACTERISTICS OF ALUMINUM ALLOY PLATES FOR WING SKINS Quarterly Report, 3 Sep.–3 Dec. 1965

G. E. Nordmark, B. W. Lifka, and J. G. Kaufman 15 Dec. 1965 43 p ref

(Contract AF 33(615)-2012)

(AD-625454) CFSTI: HC $2.00/MF $0.50

The fracture toughness, fatigue properties and corrosion resistance of 2020-T651, 2024-T851, 2219-T851 and 7001-T75 are being determined. Fracture-toughness tests of 1-in. specimens of the 2020-T651, 2219-T851 and 7001-T75 were completed during the past quarter. The fracture toughness of 2020-T651 is lowest; those of 7001-T75 and 2024-T851 are higher but still about 20 percent below that of 7075-T651 (from AF33 (657)-11155). The fracture toughness of 2219-T851 is exceptionally high, equalling or exceeding that of 7075-T7351. Fatigue tests of center-notched specimens of 2020-T651 and 2219-T851 are complete. Cracks initiate in about the same number of cycles for 2219-T851 as for 2024-T851, and slightly sooner than in 2020-T651 and 7075-T651. Cracks propagate more slowly in 2219-T851 and 2020-T651 than in some of the other alloys, but 2020-T651 fails at shorter crack lengths. Corrosion tests show that 2020-T651, 2024-T851 and 2219-T851 are highly resistant to exfoliation attack and to stress-corrosion cracking in any direction at stresses up to 75 percent of the yield strength, similar to the case for 7075-T7351. Author (TAB)

N66-18539# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEM OF THE BEHAVIOR OF HEAT RESISTANT ALLOYS IN CONTACT WITH SODIUM IN STRESSED STATE

G. P. Benediktova and S. T. Kishkin 8 Dec. 1965 12 p Transl. into ENGLISH from Tr. Aviatsionyy Inst. (Moscow), no. 158, 1964 p 29–34

(FTD-TT-65-1050/1+2+4; AD-625148) CFSTI: HC $1.00/MF 0.50

The article discusses stress corrosion of heat-resistant alloys in contact with Sodium containing admixtures. TAB

N66-18569# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

INVESTIGATION OF SOLIDIFICATION OF HIGH-STRENGTH STEEL CASTINGS Interim Report, Oct. 1, 1963–Sep. 30, 1964

R. V. Barone, H. D. Brody, and M. C. Flemings [1964] 84 p refs

(Contract DA-19-020-AMC-5443(X))

(AMRA-CR64-04/3; AD-624987) CFSTI: HC $3.00/MF $0.75

A numerical technique was employed to compute microsegregation in alloys in which (a) the final solidification temperature and composition is variable, and (b) substantial diffusion occurs in the solid during and after solidification. In iron-26% nickel alloy, segregation ratio obtained is from 1.15 to 1.28 depending on solidification conditions. These results are in qualitative agreement with theory. Dendrite morphology was examined in iron–nickel alloys containing from 10 to 26% nickel, and in iron–nickel–carbon alloys containing about 26% nickel and up to 0.42% carbon. 'Cellular' structures result in the alloys studied under conditions of low solute content and high cooling rate. Lower cooling rates and higher solute contents produce a more complex dendrite structure, with secondary and tertiary branching. Primary dendrite arm spacing in the ingots studied ranged from about 40 to 700 microns, depending on alloy analysis and cooling rate. Dendrite arm spacing in the alloys studied generally increase with (a) decreasing cooling rate, (b) increasing nickel content (at least in the range of 15 to 26% nickel, and (c) carbon additions. Author (TAB)

N66-18584# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

INVESTIGATION OF FRACTURE IN CONNECTION WITH HOT DEFORMATION PROCESSING OF METALS Final Report

Nicholas J. Grant, Peter Bridenbaugh, Barry Greene, and Robert Kane Sep. 1965 34 p

(Contract NOw-65-0106-d)

(AD-626376) CFSTI: HC $2.00/MF $0.50

Metals and alloys are normally hot worked at temperatures of 0.6 to 0.95 of their melting temperatures, in degrees Absolute, and at strain rates which may vary from as little as 0.1 to 10,000%/sec. Metals fail in tension, and are subject to tension forces in essentially all hot working operations at some stage of the working process. In the past, no one test method has been developed which encompasses these strain rates at these temperatures as a measure of hot plasticity. Recently a machine was developed which is capable of such performance, without suffering either from overstressing on loading or from impact. Three classes of materials were selected for study: (1) Udimet 700: a casting, semi-forgeable nickel-base superalloy. (2) Molybdenum and molybdenum alloy TZC: body-centered-cubic materials, single and multi-phase materials, respectively, at hot working temperatures. (3) Iron and titanium, and their alloys: to provide materials undergoing a phase transformation, and thereby to permit comparison of atomic packing on hot plasticity; also to permit hot working of two-phase alloys in which both phases are ductile. TAB

N66-18598# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MECHANICAL STRENGTH OF HIGHLY ALUMINOUS CERAMIC

N. L. Polyakova and T. P. Mikhaylova 30 Nov. 1965 13 p ref Transl. into ENGLISH from Steklo i Keram. (Moscow), v. 11, no. 3, 1954 p 16–18
(FTD-TT-64-1094/1+2+4; AD-625296) CFSTI: HC $1.00/MF $0.50

The mechanical strength of ultra-porcelain as a function of aluminum oxide content was investigated for three types of aluminous ceramics. The dependence of ultimate strength during static bending upon the annealing temperature is shown, as well as the nature of sample fracture and the values of water absorption. The greatest mechanical strength was found in samples calcined at 1340° to 1380°C and from 1380° to 1400°C. Ultimate strength during static bending of these samples reached 2000 to 2200 kg/cm^2 and 2500 to 3200 kg/cm^2. The microstructure of the ultra-porcelain samples was also studied. E.E.B.

N66-18623# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Summary Phase Report, Part III, 28 Apr. 1964–30 Oct. 1965
R. L. Ammon, A. M. Filippi, and D. L. Harrod 30 Oct. 1965 73 p refs
(Contract NOw-64-0394-d)
(WANL-PR-M-014; AD-626622) CFSTI: HC $3.00/MF $0.75

Two 80-pound, 4-inch diameter double arc cast T-222 ingots were produced and converted to three wide sheets. Excellent primary (forging) and secondary (rolling) fabricability was displayed by the material, and an approximately 1/3 ingot-to-sheet conversion yield was obtained. The sheets displayed physical and mechanical properties comparable to those previously reported for T-222, as well as good product consistency. Light microscopy, electron microscopy, and X-ray diffraction techniques were employed to study the morphology and structure of precipitated phases in T-222. Second phases present after aging T-222 were found to be dependent upon mechanical-thermal history. For example, aging as-rolled material at temperatures from 1600° to 2000°F produced the FCC monocarbide phase, (Hf,Ta,W)C, while in contrast aging solution treated material in this temperature range produced the HCP dimetal carbide phase only, (Ta,W,Hf)2C. Preferential grain boundary nucleation or phase stabilization due to dissolved oxygen or nitrogen are thought to be probable explanations for the anomolous behavior. Analysis of metallographic and mechanical property data on T-222 indicate that the interstitial strengthening effect may result from immobilization of dislocations by strain induced precipitation and/or precipitation during cooling from the solution annealing temperature. Results of this study also indicate that the optimum metallurgical condition for T-222 alloy is that obtained by recrystallization and solution annealing. Author (TAB)

N66-18686# Bettis Atomic Power Lab., West Mifflin, Pa.
HYDRIDE HABIT IN ZIRCONIUM AND IN UNSTRESSED AND STRESSED ZIRCALOY-4
W. J. Babyak Aug. 1965 39 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1757, Rev.) CFSTI: HC $2.00/MF $0.50

The habit planes for hydride precipitation in large grains of alpha zirconium and Zircaloy 4 were determined in specimens containing 161 and 136 ppm hydrogen, respectively. In zirconium, the hydride platelets precipitated on various pyramidal planes inclined to the basal plane at angles ranging from 10 to 50 and 75 and 90° C. Hydrides were most frequent at inclinations of about 20 and 90° C. In Zircaloy 4, the hydride habit was significantly different than that in zirconium. Hydride platelets were inclined to the basal plane at angles ranging from 5 to 25° C with the predominant inclination equal to 12° ; no platelets were found near the prism plane position. In both zirconium and Zircaloy 4, hydrides were principally, but not exclusively, parallel to $\{10\bar{1}1\}$ type planes. When the Zircaloy 4 grains were subjected to tension stresses of 12,100 and 19,400 psi during hydride precipitation, the hydride habit was essentially unchanged except that precipitation favored those habit planes which were more nearly perpendicular to the stress direction. The stress-orientation effect increased with the magnitude of the stress. Author (NSA)

N66-18687# California Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECT OF TEMPERATURE, STRAIN RATE AND STRUCTURE ON THE FLOW STRESS OF AN IRON-2% MANGANESE ALLOY
P. Wynblatt, A. Rosen, and J. E. Dorn 15 Sep. 1964 21 p refs
(Contract W-7405-ENG-48)
(UCRL-11512, Rev.)

The temperature, strain rate, and structure dependence of the flow stress in a polycrystalline iron-2% manganese alloy was investigated between 77 and 370°K. It was possible to identify the low temperature data from 77 to 160°K with Dorn and Rajnak's theory of the Peierls mechanism of plastic deformation. Above 160°K one or more thermally activated mechanisms must be operative, however, these were not identified. Author (NSA)

N66-18698# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
NUCLEATION AND GROWTH OF HYDRIDES IN ZIRCONIUM ALLOYS
C. Roy Sep. 1965 28 p refs
(AECL-2297) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Studies of the H_2(T) distribution in Zr alloys were undertaken by autoradiography. The heating of Zr alloy specimens (which had been hydrided, annealed above the H_2 dissolution temperature, and quenched) at temperatures as low as 80°C promoted H_2 segregation at grain-boundaries (in Zr and Zircaloy-2) and phase boundaries (in Zr–2.5 wt% Nb). This effect was most obvious in small grained material. In large grained Zr oriented hydrides also developed within the grains, apparently along the slip planes. Thus metallographic mounting techniques should not be used in studying quenched specimens without careful consideration. About 4000 ppm O_2 in solid solution in Zircaloy-2 (annealed in the $\alpha+\beta$ region) gives rise to a higher H_2 concentration in the O_2 stabilized α grains than in the transformed β grains, when hydriding was carried out at a lower temperature (650°C). Plastic deformation may enhance hydride nucleation by increasing the dislocation density. This effect was suggested by observations of slight H_2 concentration in cold-worked, as opposed to recrystallized, regions in Zr; hydride precipitation along slip bands in strained and annealed Zr specimens; and along slip planes in thermally cycled Zr and Zircaloy-2.
Author (NSA)

N66-18709# Oak Ridge National Lab., Tenn. Solid State Div.
MAGNETIC STRUCTURE PROPERTIES OF Tb-Sc ALLOYS
H. R. Child and W. C. Koehler Oct. 1965 12 p refs Presented at the Conf. on Magnetism and Magnetic Mater., San Francisco Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-P-1735; CONF-651106-2) CFSTI: HC $1.00/MF $0.50

The results of a neutron diffraction study of the magnetic structure properties of the Tb–Sc alloy system are reported. Five binary alloys with Tb content from 90 to 25 atomic percent were examined by powder techniques from 300°K down to liquid helium temperatures to determine the magnetic ordering temperatures and the magnetic structures. The dilution by Sc causes the spiral magnetic phase of Tb to remain stable over a temperature interval larger than in the pure metal. However, the Neel points of the Tb–Sc alloys fall well below those found for Tb–Y and the initial turn angles are smaller in this system. T_N falls more rapidly for Tb–Sc alloys than for Tb–Y alloys as a function of the effective spin variable $x=c(g-1)^2 J(J+1)$, where c is the atomic percent of Tb, and reaches 0°K at x about 2.5. The 25% Tb alloy shows no visible magnetic order down to 1.3°K in contrast to the Tb–Y system where magnetic order was observed with as little as 5 at.% Tb. The universal curve of T_N vs. x previously found for rare earth alloys is not obeyed in the Tb–Sc system.
Author (NSA)

N66-18712# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
PRIMARY AND SECONDARY RECRYSTALLIZATION OF ALPHA ZIRCALOY-4
D. F. Washburn Oct. 1964 39 p refs
(Contract W-31-109-ENG-52)
(KAP-3091) CFSTI: HC $2.00/MF $0.50

An investigation was undertaken to determine the primary and secondary recrystallization kinetics of cold-worked Zircaloy-4. Reactor-grade Zircaloy-4 in the form of hot-rolled plates, 0.790 and 0.150 in. thick, were cold-rolled 10, 20, 40, and 60 or 68%. Samples of the cold-rolled material were subsequently annealed in a helium atmosphere at temperatures ranging from 500° to 800°C (932° to 1472°F). Various annealing times, up to a maximum of 10,000 min (167 hr), were used. Recovery and recrystallization were followed by determining the hardness changes of the isothermally annealed samples of both the thin and thick plates. The results showed that the rates of recrystallization in both the thin and thick plates were essentially the same. Recovery had a strong effect on X-ray line-broadening, but did not cause much change in hardness. Recrystallization, after all amounts of cold work, occurred in two hours or less at 700°C, but was very sluggish at lower temperatures. Increasing the amount of cold work caused an increase in the rate of recrystallization and a decrease in the temperature at which a significant decrease in hardness occurred in a reasonable length of time. With 10% cold work, recrystallization occurred by the growth of existing grains rather than by the nucleation and growth of new grains. The activation energy for recrystallization decreased from about 105 kcal/mole for 20% cold work to about 80 kcal/mole for 40 to 60% cold work. Metallographic examination showed that the amount of cold work had pronounced effects on the secondary recrystallization process. NSA

N66-18713# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
THERMODYNAMIC BEHAVIOR OF HYPOSTIOCHIOMETRIC UO_2
E. A. Aitken, H. C. Brassfield, and R. E. Fryxell [1965] 30 p refs Presented at the IAEA Symp. on Thermodyn., Vienna, 22–27 Jul. 1965
(Contract AT(40-1)-2847)
(GE-TM-65-6-13;Conf-650704-34;SM-66-83)CFSTI:HC $2.00/MF $0.50

The ability of the UO_2-type structure to accommodate excess oxygen is well-known. Recent evidence has indicated that this structure is stable also in the hypostoichiometric state at high temperatures and low oxygen partial pressures, but its manifestation occurs as a uranium metal precipitate in the oxide after cooling from high temperatures. Further evidence is presented of its existence at high temperatures, and the variation in thermodynamic properties across its homogeneity range is described. Hypostoichiometric UO_2 evaporates congruently in a convenient experimental region. For example, during free vaporization in slowly flowing hydrogen (−40°C dew point) at 2400°C the composition evaporates congruently at an O/U of 1.88. If the temperature is decreased or the moisture content increased the congruent O/U ratio increases. The water content of the hydrogen must be at least one percent to maintain uranium dioxide at the stoichiometric value at 2400°C. When UO_2 pellets are sealed in Ta cans and heated above 1700°C, the O/U ratio of the pellet changes and reaches an equilibrium value which is governed by the oxygen activity of the atmosphere surrounding the can. UO_2 does not react with tantalum but because of the high solubility of oxygen in tantalum, the latter functions as a membrane. Congruent evaporation experiments and use of tantalum containers as membranes provide an experimental means for determining the relationship of the oxygen activity in UO_2 as a function of stoichiometry. The partial molar free energy of oxygen, $\bar{G}_{O_2}$, derived from these measurements increases almost linearly on the oxygen deficient side with increasing oxygen to uranium ratio. Near the stoichiometric composition $\bar{G}_{O_2}$ rises steeply. Using these results, together with estimated $\bar{G}_{O_2}$ values in the oxygen excess side obtained from the literature, it is shown that the data at a given temperature are consistent with a statistical model. The model assumes that the stoichiometry is achieved by allowing oxygen ions to be distributed in lattice or interstitial positions. The Frenkel energy for oxygen is 60 kcal/g atom which agrees favorably with previous estimates from oxygen self-diffusion data. The relationship between $\bar{G}_{O_2}$ and the partial pressure of the gaseous oxides, UO and UO_2, is discussed and some general comments are made about extending this experimental method to other compounds. Author (NSA)

N66-18722# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
PRIMARY AND SECONDARY RECRYSTALLIZATION OF BETA-QUENCHED ZIRCALOY-4
D. F. Washburn Nov. 1964 26 p refs
(Contract W-31-109-ENG-52)
(KAPL-3103) CFSTI: HC $2.00/MF $0.50

An investigation of primary and secondary recrystallization was undertaken on beta-quenched Zircaloy-4 with various degrees of cold-work. Hot-rolled, reactor-grade plate, 0.150 in. thick, was water-quenched after being heat-treated at 1060°C (1940°F) for one hour. The beta-quenched plate was subsequently cold-rolled 10, 20, or 40%. Small samples

were heat-treated in a helium atmosphere at temperatures in the range of 500° to 800°C (932° to 1472°F). Recrystallization was followed by hardness measurements, X-ray line-broadening, and metallographic examination. The occurrence of secondary recrystallization was determined by metallographic examination. In addition to the cold-worked material, the as-quenched Zircaloy-4 was also examined by similar methods to determine the changes brought about by the approach to equilibrium of the beta-quenched material in the absence of cold-work. An extremely large variation in X-ray intensity of the (1015) peak was observed in the beta-quenched material. At annealing temperatures in the range of 500° to about 600°C, an increase in hardness was observed after short annealing times. After 10% cold-work, it appeared that alpha grains formed by the growth of transformed beta (alpha prime) platelets. In the case of larger amounts of cold work, i.e., 20 and 40%, new alpha grains formed by nucleation and growth of new grains rather than by the migration of existing alpha boundaries. The formation of abnormally large grains by secondary recrystallization was not observed in the 10% cold-worked material, although normal grain growth occurred at the higher annealing temperatures. In the as-quenched and 40% cold-worked materials, abnormal grain growth or secondary recrystallization occurred and led to the presence both of very large and comparatively fine grains. NSA

N66-18724# Stanford Univ., Calif. Dept. of Materials Science.
INFLUENCE OF A FINELY DISPERSED SECOND PHASE ON RECRYSTALLIZATION
J. L. Brimhall, M. J. Klein, and R. A. Huggins [1963] 36 p refs
Prepared for Gen. Elec. Co., Richland, Wash.
(Contract AT(45-1)-1350)
(HW-SA-3767) CFSTI: HC $2.00/MF $0.50

The annealing behavior of internally oxidized alloys of silver containing magnesium and copper containing aluminum was studied by transmission electron microscopy. In agreement with observations on pure materials, annealing of the dispersion-hardened alloys involves the formation of subgrains from the cell structure and the subsequent growth of the subgrains into the matrix. The kinetics of both subgrain formation and growth are extremely slow in the dispersion-containing alloys, compared to pure silver and copper. This retardation could be attributed to the nature of the deformed structure, which does not contain regions of severe plastic curvature. As a result, the formation of mobile interfaces by misorientation accumulation is difficult. Particle interaction with dislocation motion during subgrain formation and direct particle interaction with the migrating subgrain boundaries during growth are discussed.
Author (NSA)

N66-18736# MSA Research Corp., Callery, Pa.
EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS Quarterly Progress Report, Jul.–Sep. 1965
R. C. Andrews and K. R. Barker 22 Oct. 1965 29 p ref
(Contract AT(11-1)-765)
(MSAR-65-149) CFSTI: HC $2.00/MF $0.50

Slight changes in mechanical properties were noted for type 316 stainless steel specimens exposed for 4000 hrs and tested in 1200°F He. An increase in rupture life and a corresponding decrease in ductility was observed for type 316 stainless steel exposed for 4000 hrs to 1200°F high-carbon Na and tested in 1200°F He. Specimens exposed for 4000 hrs to 1200°F high-oxygen Na exhibited a slight decrease in rupture life. Tests on 2 1/4 Cr–1 Mo steel specimens exposed for 4000 hrs to 1100°F He indicate a reduction in the creep-rupture life due to thermal aging. NSA

N66-18750# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
HIGH TEMPERATURE MATERIALS PROGRAM Progress Report No. 51, PART A
30 Sep. 1965 59 p refs
(Contract AT(40-1)-2847)
(GEMP-51A) CFSTI: HC $3.00/MF $0.75

Laboratory testing of Fe–Cr–Al–Y-fueled specimens exceeded 9500 hours at 950° C, and 7000 hours at 1100° C in air with virtually no U (<0.02%) detected on the cladding surface. Analysis of the fueled 2541-clad Fe–UO_2 specimen from in-pile test LTFC-1, which operated for 1007 hours at 1100° C, revealed no structural damage from irradiation. The diametric growth ranged from 0.2 to 0.7%. Weight gain data for a series of Fe–Cr–Al–Y alloys were obtained at 900 and 1100° C in static air for 9000 hrs. The lowest oxidation rates are shown by 2541 alloys containing 0.3 to 0.5% Y. Creep-rupture tests of arc-cast W at 2000 and 2200° C (62 and 67% of the absolute melting temperature, respectively) indicate a transition in the creep mechanism within this temperature range. Specimens annealed at 2400° C and tested at 2000° C are more creep resistant and have a greater rupture life than specimens annealed at 2000° C and tested at 2000° C. The reverse is shown for specimens tested at 2200° C. Multi-temperature creep tests of arc-cast W at constant stress (load) yield an apparent activation energy for creep of 160 kcal/mole. This is in reasonably good agreement with the quoted value of 140 kcal/mole for self-diffusion. Creep-rupture tests of W–25Re–30Mo (at. %) were performed at 1600 and 2200° C. The results indicate a possible material structural change at 2200° C and 0.352 kg/mm^2 (low stress). This was not indicated for the other test conditions. Along with the familiar Andrade and parabolic creep equations, two additional equation forms were found to yield excellent results in first-stage creep evaluations. Special least-squares computer programs were written to enable all the equation constants to be calculated. Refinements in the radial heat flow technique, which has been used in the past for measuring the thermal conductivity of ceramic materials, have recently allowed measurements to be made for high conductivity materials. Data for Mo were obtained from 900 to 2000° C and are in excellent agreement with previously published data for Mo. This apparatus also proved useful in measuring the electrical resistivity of refractory metals from room temperature to 2300° C. The thermoelectric properties of Cr–20 Os and Mo–10Ru–10 Os were measured as a function of temperature; Cr–20 Os was found to be a good negative thermoelement material. The resistivity of BeO was shown to be much higher than that of ThO_2; its activation energy, however, is less than that of ThO_2, suggesting that impurities control its resistivity. Studies of the effect of Re content of less than 25% in the W–Re–Mo system showed that the alloys containing 10 and 12.5% Re could not be processed using the techniques established for W–25Re–30Mo or the alloys containing 19, 21, 23, or 27% Re with 30Mo content. Other alloys containing varying amounts of Re with Mo contents of 10 and 20% were partially processed. Mo–W–Re alloys with high Mo contents were prepared and hot-rolled into sheet. Alloys containing 20, 25, and 30% Re were readily processed, but difficulty was encountered with alloys containing 5, 10, or 15% Re and 15 or 30% W. Room-temperature bend tests were conducted on hot-rolled sheet (20 to 30% Re) that was heated for 10 hours at 2000° C in H_2 before bending. These alloys showed a high degree of ductility. Sheet and tubing were also made from W–3Re and

W–5Re alloys. Welds on sheet stock made from these binary systems were strong and non-porous. Additions of 1, 2, or 5% Re to Mo reduced voids and porosities in the welds. Special purification techniques to remove O_2, N_2, and C impurities in unalloyed and alloyed Mo result in an increase in ductility and an improvement in weldability. NSA

N66-18752# Stanford Univ., California. Dept. of Materials Science.

STRUCTURE OF DEFORMED INTERNALLY OXIDIZED ALLOYS

J. L. Brimhall and R. A. Huggins [1963] 30 p refs

(Contract AT(45-1)-1350)

(HW-SA-3765) CFSTI: HC $2.00/MF $0.50

The structure of deformed internally oxidized alloys of silver containing magnesium and copper containing aluminum were studied by thin film transmission electron microscopy. With low to moderate amounts of strain, the deformation structure in the dispersion-hardened alloys was found to consist of a high density of dislocations arranged in a random distribution or in a very fine, but poorly defined, cell structure, depending on the fineness of the dispersion and amount of deformation. In contrast, both pure copper and silver show relatively large, distinct cell structures. The particular structures in the alloys are believed to result from particles acting as both dislocation sources and deflectors. The lack of a pronounced deformation texture and regions of severe local plastic curvature after heavy deformation can also be traced to the formation of dislocations on many slip systems and a lack of local concentrations of dislocations of predominantly one sign. Author (NSA)

N66-18754# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.

QUARTERLY METALLURGICAL PROGRESS REPORT NO. 28, AUGUST 1–SEPTEMBER 30, 1965

A. H. Roberson et al [1965] 19 p refs

(Contract AT(11-1)-599)

(USBM-RC-1205) CFSTI: HC $2.00/MF $0.50

Five articles are included; separate abstracts were prepared for 4. The remaining article contains brief information on thorium alloy systems. NSA

N66-18755# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

ON THE MECHANISM OF THE RHENIUM-ALLOYING-EFFECT IN GROUP IV-A METALS

C. S. Wukusick 20 Nov. 1964 19 p refs

(Contract AT(40-1)-2847)

(GEMP-314) CFSTI: HC $1.00/MF $0.50

The mechanism by which Re improves the ductility of Group VI-A metals, Cr, Mo, and W was investigated. Spinodal decomposition is postulated to be the mechanism. The essential feature of the mechanism is the removal of interstitial impurities from solution in the matrix by formation of clusters in a more or less oriented array. Dislocation mobility is improved by the removal of interstitial impurities. Data favorable to the postulation include the solubility–temperature relations, elastic constants of the base metals, crystal structure of the solutes, hardness data, and shape and distribution of equilibrium precipitates in in Cr–Ru alloys. NSA

N66-18757# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

COMPARATIVE CREEP-RUPTURE PROPERTIES OF D-43 AND B-66 ALLOYS

R. L. Stephenson [1964] 23 p refs Presented at the Symp. on Phys. Met. of Refractory Metals, French Lick, Ind.

(Contract W-7405-ENG-26)

(ORNL-P-1634; Conf-651025-2) CFSTI: HC $1.00/MF $0.50

Creep-rupture properties of D-43 (Nb–10% W–1% Zr–0.1% C) and B-66 (Nb–5% V–5% Mo–1% Zr) were determined to 1000 hr so that a valid comparison of their suitability for high-temperature structural applications could be made. The results showed that D-43 alloy was characterized by a stable microstructure at temperatures up to 1204°C. In contrast, B-66 alloy was characterized by rapid diffusion-controlled processes (rapid grain-boundary motion and low recrystallization temperature) and as a result exhibits inferior long-time high-temperature creep properties. NSA

N66-18765# California Univ., Berkeley. Lawrence Radiation Lab.

THE ELECTRICAL RESISTANCE OF BISMUTH FROM 25 TO 80 KILOBARS

David Phillips and George Jura Aug. 1964 7 p refs

(Contract W-7405-ENG-48)

(UCRL-11639) CFSTI: HC $1.00/MF $0.50

The electrical resistance of bismuth was carefully investigated in the pressure region between 30 and 90 kbars. No discontinuities were found in the electrical resistance in this region. However, this does not necessarily mean that the phase changes found by Bridgman (Proc. Amer. Acad. Arts and Sci., 79; 425(1942)) at 45 and 64 Kg cm^{-2} do not exist. Author (NSA)

N66-18773# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Nuclear Materials Div.

STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEEL Status Report, Period Ending 1 Sep. 1964

McIntyre R. Louthan, Jr. Feb. 1965 20 p refs

(Contract AT(07-2)-1)

(DP-957) CFSTI: HC $1.00/MF $0.50

Stress corrosion cracking of austenitic stainless steel is being investigated to develop a fundamental understanding of the phenomenon. The status of studies relating specimen microstructure and dislocation substructure to the susceptibility to stress corrosion cracking are presented. The results show that anodic dissolution plays a major role in the nucleation and propagation of stress corrosion cracks. The susceptibilities of different heats of the same type of steel to cracking are quite different, and these differences are not attributable to differences in the composition of major alloying elements, material hardness or dislocation substructure. It is also shown that the relative rate of preferential attack at dislocation arrays and stacking faults in thin foils of type 304 stainless steel exposed to dilute NaCl solutions increased with increasing temperature and was more rapid in heats of steel which were most susceptible to cracking in bulk tests. Author (NSA)

N66-18788# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.

THERMAL RADIATION ABSORPTION OF METALS AND LAYERED INSULATIONS AT 80°K

B. Colyer Jan. 1965 16 p refs
(NIRL-R-83) HMSO: 2s 6d

Values of thermal radiation absorption at 80°K for constructional metals (with various surface treatments) and layered insulations were measured. The experimental method and the method of calculation of results are described. Some suggestions are made for the effective insulation of laboratory equipment. Author (NSA)

N66-18816# Denver Research Inst., Colo.
PHASE EQUILIBRIA OF THE TANTALUM-RICH REGION OF THE TANTALUM–TUNGSTEN–HAFNIUM AND TANTALUM–TUNGSTEN–ZIRCONIUM SYSTEMS Quarterly Progress Report No. 2
Donald T. Klodt and Albert S. Yamamoto Mar. 1965 7 p
(Contract AT(11-1)-1092)
(DRI-1092-202) CFSTI: HC $1.00/MF $0.50

The solid-state phase equilibria at 1600, 1300, and 1100°C are being determined for the tantalum-rich regions of the Ta–W–Hf and Ta–W–Zr alloy systems. Alloys for the investigation are prepared by arc melting charges consisting of a 60 wt % Ta–40 wt % master alloy with appropriate additions of tantalum and hafnium or tantalum and zirconium. The as-cast alloys are homogenized by means of a high-temperature heat treatment *in vacuo* prior to the vacuum annealing treatments at the three isothermal levels. Metallographic examination of the annealed structures and X-ray-diffraction studies of the alloys are the principal techniques employed to determine the phase equilibria. The results of the metallographic examination of as-cast alloy structures are summarized and a discussion of the high-temperature vacuum annealing furnace and the annealing procedures used are presented. Author (NSA)

N66-18821# Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
STUDY OF BASE METAL TO BE USED IN RESEARCH ON BRITTLE FRACTURE OF LARGE WELDED ASSEMBLIES. IMPACT STRENGTH, ROBERTSON AND PELLINI TESTS ON SUPER ELSO Quarterly Report No. 3, Sep. 1–Dec. 31, 1964
Jan. 1965 12 p Transl. into ENGLISH from French
(Contract EURATOM-031-64-5 TEEF)
(EURAEC-1282) CFSTI: HC $1.00/MF $0.50

Impact strength, Robertson, and Pellini tests for brittle fracture were performed on specimens taken from the center and skin of Super Elso chromium–nickel steel plate. All tests show a higher transition temperature for the specimens taken from the center. NSA

N66-18827# Pyromet Co., San Carlos, Calif.
FEASIBILITY OF BRAZED JOINTS BETWEEN CB-1 ZR ALLOY AND ALUMINA CERAMICS
R. S. Kirby and J. D. La Motte Los Alamos, N. Mex., Los Alamos Sci. Lab., 25 Aug. 1964 25 p Prepared for Los Alamos Sci. Lab.
(Contract W-7405-ENG-36)
(LA-3302) CFSTI: HC $2.00/MF $0.50

Two brazing systems were developed for ceramic-metal seals whose helium leak-rate was less than 1×10^{-9} cc/sec. Nickel plated Mo–Mn metallized Al_2O_3 ceramics were brazed to Nb–1 Zr metal components using a Cu–45 wt % Ni filler alloy. Unmetallized Al_2O_3–0.5 wt % Y_2O_3 ceramics were brazed to Nb–1 Zr metal components using a Ti–48 wt % Zr–4 wt % Be alloy. Both types of joints remained leak-tight during limited cycling tests at 1000° C but failed during the first 1100–1200° C cycle. Neither system was considered suitable for use above 1000° C as developed. Author (NSA)

N66-18836# Los Alamos Scientific Lab., N. Mex.
IRRADIATION DAMAGE TO CERAMICS, METALLIC-CERAMIC BONDS, AND BRAZING ALLOYS
Alton J. Patrick 26 Apr. 1965 45 p refs
(Contract W-7405-ENG-36)
(LA-3285) CFSTI: HC $3.00/MF $1.00

Irradiation damage to ceramics, metallic-ceramic bonds, and brazing alloys is described for a temperature range of 700° to 970°K. Data are presented for an accumulated thermal neutron flux from 1.36×10^{21} to 2.77×10^{21} and for an accumulated fast neutron flux (>1 Mev) from 1.5×10^{20} to 3.17×10^{21}. These experiments were carried out in the MTR at Arco, Idaho, and in the LAMPRE reactor at Los Alamos Scientific Laboratory. In this temperature range the samples tested of BeO, MgO, magnesia spinel, and Y_2O_3 were found to be unsatisfactory. 97.5% Al_2O_3 (Al-300), 98% Al_2O_3+2% Y_2O_3 (Al-13), and 99.5% Al_2O_3+0.5% Y_2O_3 (Al-14) were found to be the most resistive to irradiation damage. The electrical resistivity of the ceramics tested was lower after irradiation. Author (NSA)

N66-18859# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Annual Summary Report, Period Ending Oct. 31, 1964
R. H. Chambers, T. A. Trozera, and J. L. White 15 Jan. 1965 100 p refs
(Contract AT(04-3)-167)
(GA-5734) CFSTI: HC $3.00/MF $1.00

Transmission electron microscopy of Ta single crystals deformed to large strains did not show a cell structure unless the deformed crystal was heated in an oxygen atmosphere prior to thinning. No difference was observed between as-rolled crystals and those given a thermal treatment without oxygen. The results indicate that the oxygen pins the dislocations and/or modifies their structural arrangement. It was not possible to isolate the mechanism. Tungsten single crystals of very high purity were prepared from vapor-deposited stock by electron-beam floating-zone melting. Additional purification was attempted by solid-state extraction, with inconclusive results, and by electrotransport, which appeared quite successful. Methods of acoustical spectroscopy and high-amplitude modulus-defect measurements were applied to the study of the mechanical state of a metal. From the studies it appears that the motion of dislocations in the bcc transition metals is controlled by thermally activated processes possessing an energy spectrum with a number of broad bands. There is evidence that the activation energy of some of these bands may be reduced by the application of stress, i.e., that the thermal activation event may be stress-assisted. Furthermore, the highest energy process appears to possess the largest rate of energy reduction by stress or activation volume. Measurements of the stored-energy release on annealing specimens of irradiated and cold-worked Mo were performed. Two important release peaks were found in the irradiated specimens, in the vicinities of 200 and 700° C, and the more highly irradiated specimens show possibilities for additional annealing peaks. Author (NSA)

N66-18865# Los Alamos Scientific Lab., N. Mex.
RADIATIVE AND CONDUCTIVE OPACITIES AND MONOCHROMATIC ABSORPTION COEFFICIENTS FOR IRON AND ALUMINUM

Arthur W. Cox Apr. 1962 118 p
(Contract W-7405-ENG-36)
(LAMS-3017) CFSTI: HC $4.00/MF $0.75

Reported are tentative data on: the iron opacity in the temperature range of 0.1 to 2.0 kilovolts and the density range 1×10^{-3} to 3×10^{2} g/cm^3; iron monochromatic absorption coefficients and opacities in the temperature range of 0.002 to 1.0 kilovolt with certain selected densities; and the aluminum monochromatic absorption coefficients and opacities at the same temperature-density points as for the iron monochromatic absorption data. Author (NSA)

N66-18881# Los Alamos Scientific Lab., N. Mex.
PHASE RELATIONSHIPS OF THE HIGH CARBON PORTION OF THE LANTHANIDE DICARBIDES
N. H. Krikorian, T. C. Wallace, and M. G. Bowman [1964] 17 p refs Presented at the Intern. Colloq. on Semi-metallic Derivatives, Paris
(Contract W-7405-ENG-36)
(LA-DC-6819; CONF-650913-1) CFSTI: HC $1.00/MF $0.50

A study of the rare earth dicarbides as well as YC_2 and LaC_2 to determine the MC_2-C eutectic temperatures, and the tetragonal to cubic transformation temperatures by thermal analysis techniques is reported. Microhardness measurements of the dicarbides are also reported. Lattice parameters of the tetragonal dicarbides were measured as well as the parameters of the high temperature cubic form of some of the dicarbides. Author (NSA)

N66-18889# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Dept.
CORROSION OF ZIRCALOY-2, WEAR AND CREVICE EFFECTS
W. K. Winegardner 25 Aug. 1965 6 p refs Presented at the Meeting of the Inland Empire Sect. of the Natl. Assoc. of Corrosion Engr., 17 Sep. 1965
(Contract AT(45-1)-1830)
(BNWL-SA-313)

The localized corrosion of Zircaloy-2 by wear or fretting and crevices in the PRTR is discussed. It is concluded that wear and concentration of lithia in heated crevices can initiate localized corrosion of Zircaloy-2 reactor core components. NSA

N66-18897# Denver Research Inst., Colo.
DETERMINATION OF PHASE EQUILIBRIA IN THE SYSTEM BeO–ThO_2 Second Quarterly Report
Henry E. Otto 15 Mar. 1965 8 p
(Contract AT(11-1)-1092)
(DRI-1092-201) CFSTI: HC $1.00/MF $0.50

Studies of the BeO–ThO_2 system indicate that eutectic reaction occurs between 70 and 74 mole percent BeO at a temperature of about 2150°C. The limits of solid solubility of BeO in ThO_2 at 2760°C as indicated by ceramographic inspection is less than 1.0 mole percent BeO. Solid solubility studies of ThO_2 in BeO at temperatures in excess of 2300°C indicate that the extent of solid solubility is less than 0.25 mole percent ThO_2. Author (NSA)

N66-18899# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
INVESTIGATION OF CORROSION FILMS ON INCONEL AND AISI TYPE 304 STAINLESS STEEL BY TWO NEW TOOLS: THE SPINNING-SOURCE MASS SPECTROGRAPH MICROPROBE AND THE SCANNING ELECTRON MICROSCOPE
W. M. Hickam, G. G. Sweeney, and W. T. Lindsay, Jr. Jan. 1965 28 p refs Prepared for Bettis Atomic Power Lab.
(Contract AT(11-1)-GEN-14)
(WERL-1114-1) CFSTI: HC $2.00/MF $0.50

The results of a preliminary study on the use of the spinning-source mass spectrograph microprobe and the scanning electron microscope to investigate surfaces of Inconel and AISI type 304 stainless steel corroded in high temperature water are reported. The results showed that the scanning electron microscope has great potential usefulness for the study of corrosion reactions. This results in part from the unusual contrast-producing process, which can reveal surface features not easily distinguished by other means, and in part from the fact that the examination is nondestructive and does not require surface replication. The spinning-source mass spectrograph microprobe in its present state of development is less suited to sampling very thin ($<1\mu$) oxide films than to thin layers of unoxidized metal. NSA

N66-18903# Atomics International, Canoga Park, Calif.
EFFECT OF EXTENDED EXPOSURE TO HEATED LiH ON TENSILE PROPERTIES OF 347 AND 321 STAINLESS STEELS
R. S. Neymark 7 Jan. 1965 35 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-10885)

Tensile specimens of Type 321 and of Type 347 stainless steel that which were exposed in LiH exhibited similar tensile properties to control specimens that were concurrently exposed in helium. The elongation observed in several test conditions with both Types 321 and 347 was as low as 18 to 20%, whether exposed in LiH or in helium. Type 316 had exhibited minimum elongations of about 22 to 23% under equivalent exposure and test conditions, and would be preferred over Types 321 or 347 if maximum ductility under all conditions was essential. Weight changes were determined for tabs of Type 347, 316, and 19-9 DL, which were included in the LiH with the tensile blanks. Type 316 had the smallest weight change and 19-9 DL the greatest, but none corroded appreciably (the maximum rate was less than 0.0004 inches per year). NSA

N66-18911# Battelle-Northwest, Richland, Wash. Metallurgy Research Section.
ON THE COMBINED EFFECTS OF TEMPERATURE AND IRRADIATION ON THE MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEELS
J. E. Irvin, A. L. Bement, and R. G. Hoagland Jan. 1965 26 p refs
(Contract AT(45-1)-1830)
(BNWL-1) CFSTI: HC $2.00/MF $0.50

The effects of neutron irradiation and temperature on the mechanical properties of AISI 348 and 304 stainless steels were determined using smooth and notched tensile specimens containing different amounts of cold work. Smooth tensile specimens were irradiated at about 50°, 290°, and 750°C. Room temperature and 300° C tests on specimens in both the annealed and 25% cold worked conditions showed a marked reduction in ductility with increasing exposure and increasing test temperature. Damage accumulation occurred more rapidly at the intermediate irradiation temperature. Notched tensile specimens of AISI 348 stainless steel in the annealed, 10, 20, and 40% cold worked conditions were irradiated at about 290°C and tested at room temperature. The mode of fracture was ductile in nature throughout the range of cold work and neutron exposures studied. The effects of cold work, temperature, and chemical composition on the metallurgical stability of these materials

were examined using magnetic measurements and X-ray diffraction. The magnetic susceptibility of both materials containing up to 70% cold work was determined before irradiation. No measurable change was noted in the magnetic susceptibility of either the annealed or 25% cold worked materials that were irradiated to exposures of 1.5×10^{21} neutrons/cm^2. Also, no changes in structure were observed. NSA

N66-18927# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
A RESEARCH PROGRAM ON THE EFFECT OF SUBSTRUCTURE ON THE IRRADIATION STABILITY OF ASTM A302 GRADE B STEEL Quarterly Progress Report No. 1
T. A. Trozera and P. W. Flynn 2 Jun. 1965 12 p
(Contract AT(04-3)-167)
(EURAEC-1410; GA-6454) CFSTI: HC $1.00/MF $0.50

Samples from a 10-cm-thick plate of ASTM A302-B steel were taken in the three principal directions and tested in tension. The lower yield stress and ultimate tensile stress are ±1.5% in the three directions. A number of samples were also given various prestrain and heat treatments. A combination of 0.06 prestrain followed by a 475° C heat treatment for two hours had the following results: the lower yield stress was increased 22%; the ultimate tensile strength was increased 4%; and the uniform elongation was about the same as for samples tested in the quenched and tempered condition (as-received). Author (NSA)

N66-18932# Los Alamos Scientific Lab., N. Mex.
STUDIES ON THE EQUILIBRIUM TEMPERATURE FOR THE PLUTONIUM ALPHA-BETA TRANSFORMATION
J. W. Anderson, R. R. Gilmore, and W. J. Maraman [1964] 27 p refs Presented at the Roy. Commonwealth Soc., 3d Intern. Conf. on Plutonium, London, 22–26 Nov. 1965 Submitted for Publication
(Contract W-7405-ENG-36)
(CONF-651102-6; LA-DC-7278) CFSTI: HC $2.00/MF $0.50

The equilibrium temperature for the alpha-to-beta phase transformation of plutonium was determined to be 117.0±0.5° C by measurement of the electric resistivity of thin, high-purity specimens. Author (NSA)

N66-18939# Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.
THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report No. 4
B. N. Ferry Jun. 1965 16 p ref
(Contract AT(40-1)-3208)
(EURAEC-1424) CFSTI: HC $1.00/MF $0.50

The percentage of nitrogen dissolved in type 304 stainless steel was measured as a function of the nitriding time at 1000° F for different ammonia–hydrogen ratios. This information enables nitriding and diffusion anneal treatments to be combined. Two torsional pendulum experiments were performed and the relaxation spectrum obtained for unnitrided type 304 stainless steel at 0.50 cps frequency. No internal friction peaks occurred between 80 and 423° F. The mean internal friction (logarithmic decrement) values were 0.0016 for the first and 0.0021 for the second experiments. NSA

N66-18941# Toledo Univ., Ohio. Research Foundation.
A STUDY OF THE OXIDATION OF ZIRCONIUM–NIOBIUM ALLOYS IN THE TEMPERATURE RANGE 300°–500°C Final Technical Report
Otto Zmeskal and Kuang-Hui Lin 3 Mar. 1965 68 p refs
(Contract AT(11-1)-1000)
(COO-1000-1) CFSTI: HC $3.00/MF $0.75

The kinetics and mechanism of oxidation and zirconium and zirconium–niobium alloys were investigated at 400, 500, and 600° C in the oxygen stream of the pressure range 1-760 torr for time periods up to 100 hours. The oxidation rate measurement was made by a continuous gravimetric method. Photomicrographs and electron micrographs of the cross section of the oxide-metal interface and the oxide surface were taken in order to study the structure and development of oxide films. It was found that the oxidation behavior of the materials was governed by whether the specimen had been subjected to "degassing" prior to oxidation measurement. The "degassed" zirconium specimen exhibited a characteristic rate curve which could be divided into three distinct sections. A horizontal transition region, representing a negligible rate of reaction, always appeared in the middle section of the curve. The length of this transition region becomes progressively shorter with increasing oxygen pressure. The electron micrographs supported the presumption that the presence of the horizontal transition region can be ascribed to the formation of some protective oxide film. The shapes of the reaction rate curves for the "degassed" alloys varied widely with the composition, temperature, and pressure. The "un-degassed" zirconium at both 500 and 600° C, and 760 Torr pressure oxidized according to approximately parabolic relationship. The activation energy between 500 and 600° C was 21.8 kcal/g-mole. The oxidation of the "un-degassed" alloys proceeded almost linearly with time. The influences of oxygen pressure and temperature on the oxidation of zirconium and zirconium alloys were appreciable, but the nature of pressure effect was rather complex. The photomicrographs supported the kinetic data to show that alloying of niobium with zirconium increased the reactivity of the material toward oxygen. Author (NSA)

N66-18942# Rensselaer Polytechnic Inst., Troy, N. Y.
STUDIES OF SINTERING Annual Report
Fritz V. Lenel Feb. 1965 15 p refs
(Contract AT(30-1)-2408)
(RPI-2408-1) CFSTI: HC $1.00/MF $0.50

The purpose of this project is to study the mechanism of materials transport during sintering of crystalline solids. An experiment was completed, in which the sintering of a silver sphere to a silver plate under an applied external load at temperatures in the range of 800° C was investigated. It was found that the dependence of strain rate (rate of increase in neck area between sphere and plate) upon stress changes rapidly in the stress range from 60 to 60×10^{-5} dynes/cm^2. At low stresses the strain rate approaches proportionality to stress; at high stresses it is proportional to the 4.5th power of the stress. This indicates that the material transport mechanism changes from one of Herring–Nabarro microcreep to one by dislocation motion controlled by dislocation climb. A similar experiment on the sintering of calcium fluoride is now under way. In this case the type of material transport is to be determined by observing whether a finely divided inert second phase in the calcium fluoride moves with the matrix material or not during a model experiment. In a supporting experiment, the sintering together of three silver wires containing finely distributed markers is to be studied. The stress due to surface tension in the sintering of a model consisting of two spheres as a function of increasing neck radius and of approach between the centers of the spheres is being calculated using a computer. Author (NSA)

N66-18947# Battelle Memorial Inst., Geneva (Switzerland).
THE RELATION BETWEEN TWINNING AND BRITTLE FRACTURE IN IRON AND IRON ALLOYS

E. Anderson and J. Spreadborough 1965 45 p refs Transl. into ENGLISH from FRENCH
(Contracts EURATOM-041-60-12 RDS; EURATOM-095-62-12 RDS)
(EURAEC-1195; EUR-2034.f) CFSTI: HC $2.00/MF $0.50

Metallographic studies indicate that the twinning behavior of iron and iron alloys can be discussed under two headings: twinning in fine-grained specimens; and twinning in coarse-grained specimens which are brittle or which exhibit ductile cleavage. In the case of the fine-grained samples twins appear around 150° K in the largest grains, being formed at the front of a Lüders band. As the temperature is lowered the number of twinned grains increases. The twinning stress is more dependent on the grain size than the stress necessary for deformation by slip, so that twinning in fine-grained specimens is accounted for by a simple yield propagation model. In specimens of the second group, deformed twins, and fine twins formed by the passage of cracks are observed. Since the oxygen content of the materials is quite high, and since the fractures of samples examined in the region of the ductile-brittle transition temperature were almost always of the mixed inter-intracrystalline type, it is felt that all the observed brittle fractures are intercrystalline in origin. Author (NSA)

N66-19021# Joint Publications Research Service, Washington, D. C.
STUDIES IN ELECTRON-BEAM MELTING OF METALS
17 Feb. 1966 28 p refs Transl. into ENGLISH from Russian (JPRS-34181; TT-66-30622) CFSTI: $1.00

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N66-19022 Joint Publications Research Service, Washington, D. C.
EFFECT OF ELECTRON-BEAM MELTING ON THE PROPERTIES OF BALLBEARING STEEL ShKh15
Yu. M. Yefimenko *In its* Studies in Electron-Beam Melting of Metals 17 Feb. 1966 p 1–6 refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Mater. (Kiev), v. 1, no. 4, Jul.–Aug. 1965 p 477–480 (See N66-19021 09-17) CFSTI: $1.00

The effect of electron-beam melting on the physical properties of ballbearing steel ShKh15 are investigated. Melting was performed on the U-143 type installation with a radial electron-beam heater, under high vacuum in the order of 5×10^{-4} to 5×10^{-5} mm Hg. Tests results indicate that electron-beam melting of ballbearing steel ShKh15 removes or lowers content of harmful impurities and gases, and significantly improves the physical, mechanical, and electrochemical properties of the steel. Especially effectively, electron-beam melting affects the cyclical strength of the steel, increasing the fatigue-strength by 33%, to the highest level of indices of domestic ballbearing steel ShKh15 and foreign steels of the same class. It is concluded that steel produced by electron-beam melting surpasses steel produced by vacuum arc and electroslag remelting in terms of cyclical strength, corrosion stability, and tensile strength during hydrogen-charging. M.R.W.

N66-19023 Joint Publications Research Service, Washington, D. C.
STATISTICAL ANALYSIS OF THE DIRECTIONS OF PREFERENTIAL GROWTH IN MOLYBDENUM SINGLE CRYSTALS OBTAINED BY ELECTRON BEAM, LEVITATION ZONE RECRYSTALLIZATION
A. I. Pekarev, Yu. D. Chistyakov, and G. N. Shchirenko *In its* Studies in Electron-Beam Melting of Metals 17 Feb. 1966 p 7–16 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), no. 3, May–Jun. 1965 p 65–72 (See N66-19021 09-17) CFSTI: $1.00

A statistical analysis is conducted of preferential direction of growth of 67 single crystals of molybdenum, obtained by levitation electron beam recrystallization. The most objective characteristics of preferred direction of growth of single crystals is the direction or region with the maximum frequency of orientations. Such direction had the coordinates: $\bar{X}=23.6°$ and $\bar{Y}=1.8°$, where the frequency of orientations with $Y=1.8°$ substantially exceeded equal distribution of the directions of axes. Consequently, in the given case the narrow region is obtained with preferred directions of growth, located near the zone with axis [010]. To check the hypotheses on the connection of preferential direction of growth of single crystals with close-packed planes a statistical analysis is conducted of five regions of a stereographic triangle with the centers (001), (101), (111), (112), and (103). It is shown that the regions of preferential direction of growth have the centers (001) and (103). The obtained result agrees with the preceding conclusions. Author

N66-19024 Joint Publications Research Service, Washington, D. C.
GROWING SINGLE CRYSTALS OF REFRACTORY METALS AND ALLOYS WITH A GIVEN CRYSTALLOGRAPHIC ORIENTATION BY ELECTRON BEAM ZONE MELTING
Ye. M. Savitskiy, G. S. Burkhanov, G. L. Tsarev, and N. N. Bokarev *In its* Studies in Electron-Beam Melting of Metals 17 Feb. 1966 p 17–20 refs Transl. into ENGLISH from Pribory i Tekhn Eksperim. (Moscow), no. 4, Jul.–Aug. 1965 p 248–250 (See N66-19021 09-17) CFSTI: $1.00

A method is presented for growing single crystals of the pure metals tungsten, molybdenum, tantalum, and others and their alloys with assigned crystallographic orientation by means of electron-beam zone melting. Preparation of primers, and also the attachment for its introduction for growing oriented single crystals are described. The effectiveness and accuracy of the method are considered for separate examples. Author

N66-19038*# Vitro Labs., West Orange, N. J.
ELECTROPHORETIC DEPOSITION OF GRADATED OXIDATION RESISTANT COATINGS ON TANTALUM-10 TUNGSTEN ALLOY
P. F. Campbell, K. A. Gebler, and M. H. Ortner Langley Station, Va., NASA. Langley Res. Center, Jun. 1965 93 p refs
(Contract NAS1-3533)
(NASA-CR-66068) CFSTI: HC $3.00/MF $0.75 CSCL 11F

Experimental equipment was successfully tested for the preparation of two-component electrophoretic coatings which are continuously gradated in composition over a thickness of 4–8 mils. A variety of intermetallic compounds and refractory oxides were screened as pellets and as coatings for potential use as gradated coatings for the protection of Ta–10W from oxidation at temperatures above 3000°F. Gradated coatings

consisting of $MoSi_2$–CaO-stabilized zirconia and WSi_2–2%TiO_2/CaO-stabilized zirconia were chosen for application to test specimens. Tensile specimens, leading edge specimens, and coupons were coated with each of the chosen systems and these were sent to NASA for evaluation. Author

N66-19103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF SEVERAL OXIDATION-RESISTANT COATINGS ON Cb-10Ti-5Zr ALLOY SHEET AT 2000°F, 2400°F, AND 2700°F (1365°K, 1590°K, AND 1755°K)
W. Barry Lisagor and Bland A. Stein Washington, NASA, Mar. 1966 73 p refs
(NASA-TN-D-3275) CFSTI: HC $3.00/MF $0.75 CSCL 11F

Results of a study on the properties of Cb-10Ti-5Zr columbium alloy sheet with 12 oxidation-resistant coatings are presented. Oxidation tests were performed in dry air at 2000°F, 2400°F, and 2700°F at atmospheric pressure and also at pressures of 0.5 and 0.05 torr. Mechanical-property tests included room-temperature and elevated-temperature tensile tests on both uncoated and coated material before and after exposure. Test results indicate that an upper limit for protection of this alloy from oxidation is approximately 2400°F using modified silicide coatings containing titanium and chromium and that the usefulness of thin-gage coated columbium alloy sheet may be determined by substrate embrittlement rather than by oxidation. Comprehensive metallurgical examinations on as-coated and tested specimens were performed by using X-ray emission and diffraction techniques and electron-probe microanalyzer studies. Substrate thickness decreases due to solid-state diffusion during high-temperature exposures were determined. A possible embrittling mechanism for the coated Cb-10Ti-5Zr alloy sheet is postulated and supported by the metallurgical studies. Author

N66-19104*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SALT STRESS CORROSION OF RESIDUALLY STRESSED Ti-8Al-1Mo-1V ALLOY SHEET AFTER EXPOSURE AT ELEVATED TEMPERATURES
Howard B. Dexter Washington, NASA, Mar. 1966 22 p refs
(NASA-TN-D-3299) CFSTI: HC $1.00/MF $0.50 CSCL 11F

An experimental investigation of the salt-stress-corrosion cracking of residually stressed Ti-8Al-1Mo-1V alloy sheet (duplex annealed) has been carried out with bend specimens which were brake formed from 0.050-inch-thick sheet over dies with radii of 0.25, 0.5, 1, 1.5, and 2.5 inches; residual tensile stresses ranged from 25 to 65 ksi. Specimens were salt dipped in a 3.4-percent NaCl solution and exposed at temperatures from 400° to 600°F for times up to 6400 hours. Severe stress-corrosion cracking was found to occur after 20 hours exposure at 600°F for the 0.25-inch-radius specimens, but no salt stress corrosion was noted at 400°F regardless of stress. Salt stress corrosion after 3200 and 6400 hours exposure began to occur at temperatures above 400°F for the bend radii investigated. Additional tests were run to determine the relative effects of NaCl, $CaCl_2$, $MgCl_2$, sea salt, and simulated sea salt (seven parts NaCl to one part $MgCl_2$) on stress-corrosion cracking. The results showed NaCl to be the most corrosive. Conventional stress-relieving procedures were effective in eliminating stress corrosion when performed in an argon environment, but results were erratic when the specimens were stress relieved in air. Author

N66-19154# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
INTERNAL OXIDATION OF Fe-Al ALLOYS [UTLENIANIE WEWNETRZNE STOPOW Fe-Al]
Henryk Matyja and Jan Bieszkiewicz Jul. 1965 30 p refs
(INR-644/XIV/PS) CFSTI: HC $2.00/MF $0.50

The discovery of oxidation conditions that do not lead to formation of external zone of iron oxides is reported. The kinetics of the internal oxidation process were studied, and from the parabolic growth rate law $x^2=k\cdot t$ for 800, 900, 1000, and 1050°C the activation energies were calculated. It was proved that as the concentration of aluminum increases the depth of penetration decreases, and on the samples with 5.18 wt % Al the internal oxidation process was not observed. Author

N66-19174# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
INFLUENCE OF HEAT TREATMENTS ON URANIUM MONOCARBIDE UC AND U-UC CERMETS
A. Accary and R. Lucas Dec. 1965 19 p Transl. into ENGLISH from Mem. Sci. de la Rev. de Met. (France), v. 58, no. 5, 1961 p 383-387 Presented to the Journees Metallurgiques d'Automne of the Soc. Franc. de Met., Paris, Oct. 1960
(AECL-2372) CFSTI: HC $1.00/MF $0.50

The effects of heat treatment were determined as a function of time and temperature, on the one hand, and carbon content, on the other. Heat treatments were conducted in a vacuum at temperatures from 900° to 1700°C, depending on carbon content. In cermets with less than 2% carbon, a more regular dispersion of carbide grains was observed, as well as a slight increase in grain size. In cermets with more than 2% carbon, a more uniform distribution of carbide grains was noticed, along with a significant and irregular increase in grain size. It was also noted that grain shape is of a simple geometric form. In uranium monocarbide grain size increased and grain boundaries became more regular and tended to straighten. It is suggested, in the presence of metallic uranium, that migration is due to diffusion, and that the appearance of regular shapes is due to decomposition and dissolution of irregularly formed grains which have a higher surface energy. In the absence of metallic uranium, growth is due to internal stress and a reduction in intergranular area. D.T.

N66-19175# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
AN INVESTIGATION INTO THE EFFECT OF OXYGEN AND WATER-VAPOUR ON THE PROPAGATION OF FATIGUE CRACKS IN 2024-T3 ALCLAD SHEET
A. Hartman and F. A. Jacobs Jan. 1964 87 p refs
(NLR-TN-M.2123) CFSTI: HC $3.00/MF $0.75

The propagation of fatigue cracks has been studied in alclad sheet under fluctuating tension in different atmospheres. Of the principal constituents of air, water vapor had a much more severe effect than oxygen; in wet, pure argon the endurance was much shorter than in dry, pure oxygen. In air, other circumstances remaining unaltered, the endurance increased continuously at a reduction of the water vapor content; the endurance, at a water content of the air of 20 ppm being about 6 times as long as in air saturated with water. Between the limits of 30% and 100% relative humidity, as occurring in normal air, the endurance was only slightly affected. The thermodynamics and the mechanisms of the reactions of oxygen and water vapor with the metal are discussed. Author

N66-19183# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
ON THE EFFECT OF NITROGEN INTERSTITIALS ON THE RADIATION EMBRITTLEMENT OF PURE IRON

M. Castagna, R. L. Colombo (FIAT, Sez. Energia Nucl.), A. Ferro (Ist. Elettrotec. Nazl. Galileo Ferraris), F. S. Rossi, and G. Szabo-Miszenti Brussels, EURATOM, 1965 23 p refs (Contract EURATOM-004-63-10 TEEI)
(EURAEC-1347; EUR-2322.e) CFSTI: HC $1.00/MF $0.50

Experiments were performed to improve the knowledge of the influence of nitrogen present in combined or free condition in the ferritic steels used for nuclear pressure vessels. Two iron materials were hot-worked below 750°C, cold rolled to several different R.A.'s and fully annealed at 820°C in vacuo or nitrogen atmosphere. Irradiation was performed in the swimming pool reactor at a temperature not exceeding 50°C and to an integrated fast neutron (>1 MeV) flux of about 0.4×10^{19} n=cm^2. V-notch impact tests were performed on specimens both prior and after irradiation and the change in the ductile-brittle transition temperature was determined. The transition temperature for nitrogen-containing iron was about 0°C prior to irradiation and about 160°C after irradiation, while in interstitial-free iron is shifted from −60° to 0°C. While the absorbed energy above the transition temperature is in this latter material practically unchanged by irradiation, in nitrogen-containing iron it drops to about one half of its original value. Author

N66-19189# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
CATHODIC POLARIZATION OF SPENT ZINC-CONTAINING PAINTS IN SEA WATER
A. G. Khanlaroua, M. R. Khanmamedova, and M. A. Ibrahimova May 1965 14 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i Ikh Primenenie (Leningrad), v. 3, 1964 p 34–37
(T-424-R) CFSTI: HC $1.00/MF $0.50

Studies were undertaken to establish the dependence of protective zinc paints upon the chemical composition of the electrolyte. Paint coatings of 90% zinc and 10% polystyrene were tested in solutions of NaCl, KCl, Na_2SO_4, K_2SO_4, and $MgSO_4$ for two months. Tabulated data show the alterations of the electrode potential after exposures at various time periods. Experiments on the cathodic polarization of spent zinc paint coatings in sea water showed that their polarizability depends both on the chemical composition of the binder, and on the degree to which the zinc is spent. Maximum cathodic polarizability was found in paint coatings with chlorinated rubber and polystyrene bases. The deduction was made that the protective action of spent zinc paint coatings can be restored by brief cathodic polarization with currents of small density. It was concluded that the use of cathodic protection simultaneously with protective coatings of zinc paint reduced the electric current expenditures, and increased the period of effectiveness of the paint coatings. N.E.N.

N66-19226# Stanford Univ., Calif. Dept. of Materials Science.
SOME ASPECTS OF DISLOCATION DYNAMICS IN METALS AND THE INFLUENCE OF DISLOCATION DISTRIBUTION ON LOW TEMPERATURE ELECTRICAL TRANSPORT PROPERTIES
Troy W. Barbee, Jr. Nov. 1965 230 p refs *Its* Tech. Rept.-17 (Contract Nonr-225(34))
(DMS-65-33; AD-625023) CFSTI: HC $6.00/MF $1.25

The relationship between dislocation dynamics and strain hardening was investigated in polycrystalline Ta, Mo, Fe-Si, Cu, Al and single crystal LiF by determining the strain dependence of the dislocation velocity exponent m, using the macroscopic stress-relaxation technique. Dislocation structures in tantalum resulting from deformation to various values of strain at room temperature, deformed at temperatures between 400° and 1000°C, and deformed at room temperature and annealed at temperatures between 400° and 1200°C were examined by transmission electron microscopy techniques. The relationship between dislocation distribution and the low temperature electrical transport properties of metals was also investigated. The effect of dislocation distribution on the properties of high field superconductors was also considered. Calculations were made in which the effects of the strain fields of individual dislocations and the effects of dislocation distribution on the spatial variation of the conduction electron mean free path on the properties of Type I and Type II superconductors were considered. TAB

N66-19251# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF HEAT TREATMENT ON THE PHYSICO-MECHANICAL PROPERTIES OF STEELS OF THE AUSTENITE-MARTENSITE CLASS
V. S. Postnikov, V. V. Usanov, and I. M. Sharshakov 26 Nov. 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh. Uchebn. Zavedenii, Chern. Met. (Moscow), no. 11, 1964 p 149–154
(FTD-TT-65-1072/1+2; AD-625293) CFSTI: HC $1.00/MF $0.50

Data is presented on the influence of heating temperature on internal friction (viscosity), resistivity, ultimate strength and relative elongation of stainless steels of the transitional austenite-martensite class. TAB

N66-19255# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL IMPERFECTIONS OF METALS DURING RECRYSTALLIZATION
S. Z. Bokshteyn, S. T. Kishkin et al 26 Nov. 1965 15 p refs Transl. into ENGLISH from the publ. "Protsessy Diffuzii, Struktura i Svoystva Metallov. Sbornik Statey" Moscow, Izd-Vo Mashinostr., 1964 p 99–109
(FTD-TT-65-1090/1+2; AD-625154) CFSTI: HC $1.00/MF $0.50

An investigation was made of the heredity of metal structure during recrystallization and grain growth. The investigation method combined autoradiographic and microstructural analyses. The degree of perfection of separate structural zones after recrystallization was determined by their diffusion permeability, as a defective structure has a higher permeability for diffusive atoms. Diffusive saturation of specimens by a radioactive tracer was investigated by means of special donors after recrystallization. The stability or degree of imperfection of the boundaries of initial grains after recrystallization was investigated depending on the degree of purity of the material and recrystallization conditions. 'Sulim' iron, as well as iron with diffused atoms of various elements (such as tin, tungsten) at the boundaries were investigated for saturation of the boundaries of initial grains with impurities. TAB

N66-19362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ALLOYING ON THE TEMPERATURE DEPENDENCE OF THE NORMAL MODULUS OF THE ELASTICITY OF TITANIUM
S. F. Kovtun and R. A. Ul'yanov 13 Jan. 1966 13 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Moscow), v. 19, no. 2, 1965 p 263–267
(FTD-TT-65-1462/1+2+4; AD-626964) CFSTI: HC $1.00/MF $0.50

The investigations carried out showed that the best alloying elements from the point of view of raising the modulus of elasticity of titanium are Al, Cr, Mo, and Re. In this situation the concentration of the alloying elements should not exceed their solubility in the alpha phase. Lanthanum and tellurium, which lower the modulus of elasticity of titanium, noticeably increases its plasticity at low temperatures (the relative lengthening at −196 amounts to 35–40%, whereas with pure titanium, it does not go higher than 27%). Author (TAB)

N66-19382# Frankford Arsenal, Philadelphia, Pa.
STRESS-CORROSION SUSCEPTIBILITY OF ULTRAHIGH STRENGTH STEEL EVALUATED IN TERMS OF FRACTURE TOUGHNESS
Joseph H. Mulherin and Edward H. Hess Nov. 1965 35 p refs
(R-1782; AD-626013) CFSTI: HC $2.00/MF $0.50

The stress-corrosion susceptibility of several ultrahigh strength ferrous alloys is described on the basis of fracture mechanics parameters. Two general conditions were considered: first, the susceptibility of a material at various levels of tensile yield strength and fracture toughness; and second, susceptibility as a function of applied subcritical stress intensity levels. Experimentally, a notched and fatigue-cracked bendbar specimen configuration was used. Under a subcritical load, fracture of the specimen occurs upon sufficient environmentally influenced crack extension. The susceptibility criterion adopted in this investigation was the time period to catastrophic fracture of the specimen. The results are evaluated in terms of strength level and fracture toughness, and the usefulness of the data generated is examined in terms of material evaluation and application. Author (TAB)

N66-19399# Library of Congress, Washington, D. C. Aerospace Technology Div.
LIQUID STATE OF METALS—ANNOTATED BIBLIOGRAPHY Surveys of Communist World Scientific and Technical Literature, Jan. 1964–Aug. 1965
Dimitri Vvedensky 29 Oct. 1965 44 p refs
(ATD-B-65-95; AD-626598) CFSTI: HC $2.00/MF $0.50

This annotated bibliography was compiled from Soviet Satellite open sources published 1964–1965. It is the first in a series. The report is divided into two sections with data published in 1964 making up the first and data published in 1965 comprising the second. Information covered includes the following: selenium, iron, chromium, silicon, rare earth elements, nickel, sodium alloys, antimony-bismuth system, copper, cadmium-bismuth alloy, lead-tin alloy, magnetic susceptibility, germanium, liquid metal structure, sulfur, aluminum, electrode polarization, liquid metal self-diffusion, electrotransfer, indium-antimony alloys, temperature resistivity, liquid alkali metals, radiation scattering, melt density, thermochemistry, tin, Hall constant, liquid eutectics, X-ray diffraction analysis, steel, electroconvective diffusion, germanium alloys, electrokinetic effect, titanium, ultrahigh pressure melting, zirconium, aluminum oxide wetting, lead, cobalt-silicon system. Author (TAB)

N66-19441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSAIC STRUCTURE OF METALLIC POLYCRYSTALS AND EXTINCTION EFFECTS
I. A. Zazovskaya and O. N. Shivrin 15 Dec. 1965 12 p refs
Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 6, 1963 p 95–98 refs
(FTD-TT-65-1289/1+2+4; AD-625249) CFSTI: HC $1.00/MF $0.50

In radiations of molybdenum and copper there were studied the extinction effects in large- and small-grained powders of tungsten. It was established that the extinction weakens in proportion to the shortening of the length of the radiation wave. An explanation of this phenomenon is based on the optical character of the scattering of the X-rays by a mosaic crystal. Author (TAB)

N66-19454*# General Dynamics/Convair, San Diego, Calif.
MECHANICAL PROPERTIES OF HASTELLOY SHEET ALLOY R-235 AT CRYOGENIC TEMPERATURES
Jack Christian 19 Mar. 1962 13 p
(NASA-CR-54598; MRG-300) CFSTI: HC $1.00/MF $0.50
CSCL 11F

Hastelloy alloy R-235 is a nickel base alloy developed for high temperature (to 1750°F) service. It was the purpose of this investigation to determine the applicability of this alloy for structural uses at cryogenic temperatures. Parent metal and welded tensile properties and toughness, as determined by notched (K_t=6.3) tensile strengths and notched/unnotched tensile ratios, were evaluated at 78°, −100°, −320° and −423° F. The alloy was tested in the annealed and two aged conditions. The data indicate that the R-235 alloy remains as tough at cryogenic temperatures (to −423°F) as it is at room temperature for the conditions tested. This alloy does have a rather low yield strength to density ratio as compared to other high strength sheet materials, however may find application if service conditions range from very low (to −423°F) to quite high (1750°F) temperatures. Author

N66-19455*# General Dynamics/Convair, San Diego, Calif.
EVALUATION OF ELECTROFORMED NICKEL TO 301 STAINLESS STEEL RESISTANCE SPOTWELDS AT 78°F AND −423°F
L. D. Girton 25 Jan. 1962 11 p
(NASA-CR-54536; MRG-288) CFSTI: HC $1.00/MF $0.50
CSCL 11F

As evaluated by the notched tensile test .062" electroformed nickel had excellent toughness at −423°F having a notched–unnotched ratio of 1.21. The electroformed nickel resistance spotwelded to .020" type 3 :1 (0-71004) stainless steel met the shear and tension requirements of MIL-W-6858A. The .020"-301 to .062" electroformed nickel spotweld tension strengths increased in value at −423° F as compared to spotweld tension strengths in .020" type 301 welded to Inconel-X and to itself which decreased at cryogenic temperatures. Author

N66-19462*# Hexcel Products, Inc., Berkeley, Calif.
BROAD APPLICATIONS OF DIFFUSION BONDING
B. R. Garrett, H. F. Blank, and A. J. Ranadive Washington, NASA, Mar. 1966 220 p refs
(Contract NAS7-273)
(NASA-CR-409) CFSTI: HC $2.25/MF $1.25 CSCL 11F

Diffusion is the process by which matter is transported from one part of a system to another by movement of atoms. In a macroscopic sense, diffusion is enhanced by the influence of a compositional gradient, resulting in the directionalization of the transport of matter. From an atomistic viewpoint, the random motion of atoms is understood to be directionalized by application of energy or an energy gradient. This may come about due to a chemical, electrical and/or thermal energy gradient in a system, causing mass transport along the gradient. The mechanisms by which atomic motion occurs are discussed in the sections of this chapter. These considerations are basic to solid state joining of materials by diffusion. Author

N66-19476# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE FORMATION OF AN α-SOLID SOLUTION OF NITROGEN IN ZIRCONIUM AT HIGH TEMPERATURES

S. Ye. Salibekov and Yu. V. Levinskiy 15 Dec. 1965 10 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 18, no. 6, 1964 p 858–861
(FTD-TT-65-1183/1+2+4; AD-625161) CFSTI: HC $1.00/MF $0.50

An investigation was made of high-temperature (1400°–1700°C) nitration of zirconium in a furnace with a molybdenum heater in an atmosphere of nitrogen which contains less than 0.005% of oxygen. By the methods of X-ray-photographic and metallographic analyses and the measurement of the microhardness, there has been established the conformity to law of the growth of the hardest layers—the α-solid solution and nitride of zirconium (ZrN). An equation has been found which connects the summary thickness of the films of ZrN and the α-solid solution with the temperature and time of the nitration, and the energy of the activation of the process of growth of the films has been calculated and it equals 56,290 cal/mole.
Author (TAB)

N66-19530*# Battelle-Northwest, Richland, Wash.
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS Quarterly Progress Report, Oct. 1, 1965–Jan. 1, 1966
3 Jan. 1966 16 p refs
(NASA Order R-48; Contract AT(45-1)-1830)
(NASA-CR-71092; BNWL-196) CFSTI: HC $1.00/MF $0.50
CSCL 11F

The remelting of the tungsten-technetium alloys by electron beam melting was completed, radiography and density measurements made, and buttons were sealed in molybdenum cans by electron beam welding. Alloys up to 30 at.% Tc and the 60 at.% Tc were easily broken with hammer blows prior to melting, but alloys of higher Tc content, and especially the 50 at.% Tc alloy, required 6000 lb pneumatic hammer blows. The melting was performed in a 10 kW electron beam. Alloys of up to 30 at.% Tc were found difficult to melt and solidify into well formed buttons, but alloys of a higher Tc content were found to melt smoothly. The alloys were given a homogenization anneal prior to canning. The alloy buttons were sealed in molybdenum cans by electron beam welding. A table of densities of the different Tc content alloys is given.
N.E.N.

N66-19571# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MUTUAL SOLUBILITY OF COPPER AND MOLYBDENUM AND CERTAIN PROPERTIES OF ALLOYS OF MOLYBDENUM WITH COPPER
M. L. Baskin and A. V. Savin 9 Nov. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR Otd. Tekhn. Nauk: Met. i Toplivo (Moscow), no. 4, 1961 p 111–114
(FTD-TT-65-1009/1+2; AD-624908) CFSTI: HC $1.00/MF $0.50

The lattice constants of the individual phases, resistivities and coefficients of linear expansion were determined for Mo-Cu alloys (1.5-14% by weight of Cu) obtained by powder-metallurgical methods at a sintering temperature of 1600°–1700°C. Data were obtained indicating formation of a solid solution of copper in molybdenum. The solubility of copper in molybdenum at 950° C is about 1.5% by weight. The influence of carbon, silicon, silicon dioxide and nickel impurities on certain properties and the structure of the Mo-Cu alloys was established.
Author (TAB)

N66-19572# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF ANTIFRICTION ALLOYS OF THE "ALCUSIP" TYPE
M. V. Dumchus and K. M. Streyeva 26 Nov. 1965 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Tsvet. Met. (Dzaudzhikau), no. 5, 1964 p 114–118
(FTD-TT-63-1073/1+2; AD-624911) CFSTI: HC $1.00/MF $0.50

Alcusip castings over 80 mm in diameter have intolerable liquation of the lead over their height. The microstructure of alcusip is characterized by considerable nonuniformity. The ground mass—the ferrous component $Al_xFe_ySi_z$ with $CuAl_2$ crystals—is comparatively hard, while the inclusions of lead and the solid solution of copper in aluminum are soft. As the lead content in the alcusip increases, the strength and hardness decline and the relative elongation increases. Alcusip alloys show wear resistance inferior to that of B-16 alloy. Among the alcusip alloys, AMSK-1 shows the best resistance to wear. Alcusip alloys might be used as a replacement for bronze in light-duty bearings, when the specific pressure is of the order of 20 kg/cm^2 and the speed below 3 m/sec. The value of the bearing-materials characteristic, $Pv<60$kg-m/cm^2-sec, for the alcusip alloys.
Author (TAB)

N66-19680# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPERTIES AND USES OF RHENIUM
K. B. Povarova and M. A. Tylkina 10 Nov. 1965 10 p Transl. into ENGLISH from Byull. Tekh.-Ekon. Informatsii (Moscow), no. 9, 1963 p 7–11

The unique physico-chemical properties of rhenium which find application in nuclear engineering, electrical technology, electronics, and space are reviewed. Also, the use of rhenium as a catalyst, superconductor, semiconductor, and as an alloy with tungsten and molybdenum are discussed.
E.E.B.

N66-19687*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE Second Quarterly Report, Mar. 1–May 31, 1965
P. E. Kueser et al Jun. 1965 161 p refs
(Contract NAS3-6465)
(NASA-CR-54355; WAED-65-42E) CFSTI: HC $5.00/MF $1.00
CSCL 11F

Progress is reported in the development of high temperature magnetic material with satisfactory strength for rotor use. Additions of tungsten and niobium markedly increased the stability at 1025°F of martensitic type alloys over conventional systems. The prealloyed powders and composite powders to be used in dispersion strengthening of magnetic materials are being prepared. A program to determine the feasibility of a high temperature capacitor using high quality dielectric materials is discussed. Pyrolytic boron nitride was prepared in thicknesses of 1.12 mils, electroded with platinum, and exhibited electrical strengths of 10,400 volts/mil at room temperature. Its dielectric constant changed less than 1% when tested from room temperature to 1100°F. Also presented is another program which incorporates developments on alkali metal compatible ceramic-to-metal seals on combinations of materials designed into a stator with a bore seal, a transformer, and a solenoid for investigations of compatibility under electrical and magnetic stress at high temperature and high vacuum. It is reported that the vacuum loading chamber for alkali metal loading was completed. Further, the thermal vacuum chamber for evaluating the stator, transformer, and solenoid was tested at 10^{-11} torr under clean, dry, and empty conditions.
R.R.D.

N66-19701# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RECRYSTALLIZATION OF HIGH-MELTING METALS IN WELDING AND SOLDERING

N. V. Grebtsev and G. N. Klebanov 9 Nov. 1965 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. i Toplivo (Moscow), no. 5, 1961 p 62–69 (FTD-TT-65-1010/1+2; AD-624909) CFSTI: HC $1.00/MF $0.50

In the rapid heating encountered in welding, the initial recrystallization temperatures of molybdenum and tungsten rise by 250°C and 400°C, respectively, tending toward some limiting value. For tantalum and niobium, this temperature rise amounts to 120°–150°C and 170°–200°C. Under the conditions of rapid heating, considerable grain growth is observed in molybdenum at temperatures above 1600°C. It is of value to shorten the duration of heating only for welding conditions under which the basic metal is heated to temperatures near the melting point. In soldering with working temperatures below 1600°C, the duration of the process has little effect on the grain size of the ground metal. At higher soldering temperatures, it is advisable to heat with high-frequency currents. Among all of the parameters of the welding heat cycle, that exerting the strongest influence on the processes of grain growth in tantalum and niobium is again the heating temperature, followed in order of importance by the holding times above the recrystallization temperature in heating and cooling. Hence these metals must be welded with heavy currents and at high speeds, or sources that ensure highly concentrated heating and deep penetration (electron beam) should be used. TAB

N66-19715# Societe des Forges et Ateliers du Creusot (France).

FUNDAMENTAL STUDIES ON SOME FORMS OF BRITTLENESS AFFECTING HIGH-STRENGTH STEEL WELDMENTS AND ON THE MEANS TO IMPROVE MECHANICAL PROPERTIES [ETUDES FONDAMENTALES SUR QUELQUES FORMES DE FRAGILITE AFFECTANT LES JOINTS SOUDES EN ACIER DE HAUTE RESISTANCE ET SUR LES MOYEN D'AMELIORER LEURS PROPRIETES MECANIQUES]

J. Dollet, P. F. Martin, and C. Roques Brussels, EURATOM, Dec. 1965 83 p refs In FRENCH; ENGLISH summary (Contract EURATOM-073-61-12 RDF)
(EUR-2368.f; EURAEC-1419) CFSTI: HC $3.00/MF $0.75

The development of high-strength weldable steels has raised a number of brittle fracture problems connected with the presence of severe stresses or the brittleness of the metal. This second factor leads to the thorough study of problems bound up with base material heat treatment and, to the study of the weld metal and the heat-affected base metal zone, the ductility of which is important for the resistance of the structure. This accounts for the planning of a study devoted to: (1) the ductility of the martensite formed in the heat-affected zone; and (2) the embrittlement induced by welding. The results, particularly those relating to the influence of the composition on ductility, are as follows: (1) Demonstration of equivalence between austenitization time and temperature and between the austenitization conditions and N gamma grain-size. (2) Determination for the alloy steel investigated, of the correlation between the gamma grain-size and the as-quenched impact strength. (3) Confirmation of the value of aluminium as compared with all other grain-refining elements as well as of chromium as far as the alloy elements are concerned. (4) Quantitative estimate of the embrittling effect of phosphorus. (5) Determination of the importance of hydrogen, irrespective of the composition studied; this cannot be carried out separately from the comparison of the respective martensitic ranges of the base metal and of the weld metal. Author

N66-19759*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

UNIFORM VACUUM ULTRAVIOLET REFLECTING COATINGS ON LARGE SURFACES

H. Herzig Washington, NASA, Mar. 1966 10 p refs
(NASA-TN-D-3357) CFSTI: HC $1.00/MF $0.50 CSCL 11F

A method for producing uniform vacuum-deposited films on large substrates from a single, small area evaporation source is described. The procedure is being applied to the deposition of a uniform coating of magnesium fluoride on a 39-inch diameter vacuum-deposited aluminum mirror for use in the far ultraviolet. The magnesium fluoride restricts the oxidation of the aluminum and a uniformly high reflectance surface is obtained. Results of tests on a large number of two-inch square samples, arranged to duplicate the size and paraboloidal shape of the mirror, indicate that a reflectance of 82 ±2 percent at Lyman alpha can be expected. Author

N66-19762*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

GALVANIC CORROSION OF ALUMINUM ASSEMBLIES BY STAINLESS STEEL WIRE INSERTS

T. S. Humphries and E. E. Nelson 2 Mar. 1966 20 p
(NASA-TM-X-53404) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Data on the galvanic corrosion which is associated with bare and plated stainless steel inserts in aluminum assemblies are presented. Bare, cadmium plated, and silver plated stainless steel inserts which had been installed in 5456 and 2219 aluminum alloy blocks were tested in several corrosive environments—salt, brackish, and tap water and salt spray. It was found that the cadmium plated stainless steel inserts resulted in minimum galvanic corrosion of 5456 aluminum and afforded cathodic protection to 2219 aluminum. Silver plated stainless steel inserts that were tested caused severe galvanic corrosion of the aluminum assemblies and, therefore, are not recommended for use with aluminum. Author

N66-19770# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.

SOLID-STATE PRESSURE BONDING OF TITANIUM ALLOY 6Al-6V-2Sn Technical Report

Robert Fitzpatrick, Robert M. Colton, Warren C. Malatesta, and F. J. Rizzitano Dec. 1964 16 p refs
(AMRA-TR-64-48; AD-625718) CFSTI: HC $1.00/MF $0.50

High-strength titanium assemblies for Army weapon systems have been fabricated using solid-state bonding and controlled plastic deformation techniques to achieve union between individual components. For this application coalescence is induced by heating the metal about the abutting interface area between units to a temperature slightly above that of the beta transus of the alloy. At this temperature, diffusion and grain growth occur across the interfaces of abutting components producing the desired solid-state bond. During postweld cooling of the bonded area through the two phase alpha-beta region of the alloy, plastic deformation is initiated and completed at the weld area. This action refines any grains that recrystallized during the heating cycle and disperses any oxide inclusions which may have been trapped within the bond area. The final microstructure developed at the bond is typical of a wrought material and exhibits a definite grain-flow pattern throughout. It is indicated that alpha-beta titanium can be pressure-bonded to a strength and toughness approximately equal to the base material. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-18489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCTION PROCESS FOR FOAM PLASTICS
V. D. Valgin, V. N. Demin, and Ye. B. Petrilenkova 15 Dec. 1965 9 p Transl. into ENGLISH from Soviet Patent no. 167033 (Appl. no. 816862/23-4, 30 Jan. 1963) 2 p
(FTD-TT-65-1247/1+4; AD-025108) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of obtaining a foam plastic on the basis of unsaturated polyestermaleate resins, diisocyanate, water, a catalyst, and an emulsifier, by mixing the original components with subsequent foaming and hardening of the composition. To increase the stability of the foam and improve the sanitary conditions of the work, unsaturated polyestermaleate resins are used in the form of solutions of them in nonvolatile di- and polyester-acrylates. Unsaturated polyester maleates that contain chlorine may be used to give the foam plastic the properties of self-attenuation. Author (TAB)

N66-18494# Institute of Paper Chemistry, Appleton, Wis.
PRODUCTION AND EVALUATION OF LOWER BASIS WEIGHT IPC 1478 FILTER PAPER Final Report, 15 Oct.–31 Dec. 1965
D. J. Mac Laurin, Jr., Leonard R. Dearth, and J. A. Van den Akker 31 Dec. 1965 12 p
(Contract AF 33(657)-15562)
(AD-625922) CFSTI: HC $1.00/MF $0.50

The research was directed toward production and evaluation of IPC 1478 paper of reduced basis weight. It was possible to produce the filter paper at a basis weight of a little over 8 pounds per 1000 sq. ft. which is about 1/4 of the basis weight of the original IPC 1478 paper. The filtration efficiency and flow-pressure drop relationship was determined using the wind tunnel and aerosol detector described in DASA Report No. 1168. The retention of particles by the reduced basis weight paper was appreciably lower than that for the original basis weight IPC 1478 paper, as was expected. The pressure-drop across the reduced basis weight filter at a given flow was also decreased. A portion of the paper produced was impregnated with Kronisol and data were obtained on both the impregnated and unimpregnated paper. The data show that the Kronisol impregnation does not affect the retention or flow-pressure drop characteristics appreciably under the conditions of testing. Author (TAB)

N66-18524# California Univ., Los Angeles.
THE VISCOELASTIC RELAXATION MECHANISM OF INORGANIC POLYMERS. IV: SIMULTANEOUS MULTIPLE MECHANISMS
A. Eisenberg, S. Saito, and L. A. Teter 15 Dec. 1965 27 p refs Submitted for Publication Revised
(Contract Nonr-233(87))
(TR-8, Rev.; AD-625329) CFSTI: HC $2.00/MF $0.50

The viscoelastic properties of two polymers were studied in which both molecular (diffusional) motions and bond interchange were present in the glass transition region. The materials were a lanthanum (La^{3+}) doped sodium polyphosphate and an arsenic doped sulfur polymer. It is shown that (just as in the case of the acrylate polymers studied by Ferry) the two mechanisms have two different compliance curves associated with them which move with bond interchange and the other to the diffusional motion of the chains. On the basis of activation energy arguments the compliance curves are matched with the mechanisms, and the relative contributions to the total viscosity due to each mechanism are given as a function of temperature. Author (TAB)

N66-18550# Mellon Inst., Pittsburgh, Pa.
THE RELATIONSHIP BETWEEN MOLECULAR STRUCTURE, MORPHOLOGY AND THE MECHANICAL PROPERTIES OF POLYMERIC MATERIALS Technical Report, 1 Mar.–31 Aug. 1965
Guy C. Berry, Meyer H. Birnboim, William H. Hoffman, Joseph H. Magill, Hershel Markovitz et al Dec. 1965 103 p refs
(Contract Nonr-2693(00))
(TR-14; AD-626154) CFSTI: HC $4.00/MF $0.75

Contents: Crystallization kinetics of 1:3:5 tri-alphanaphthyl benzene, by J. H. Magill and D. J. Plazek; Formation of spherulites in polyamide melts: Part III 'even-even' polyamides, by J. H. Magill; Light scattering from crystalline polymer films, by G. C. Berry, J. H. Magill, and M. H. Birnboim; Polyethylene—sample molding, by W. M. Hoffman and M. H. Birnboim; Viscoelastic behavior of polystyrene, by D. J. Plazek. TAB

N66-18567# California Univ., Los Angeles. Dept. of Chemistry.
VISCOELASTIC RELAXATION MECHANISMS OF INORGANIC POLYMERS V: COUNTERION EFFECTS IN BULK POLYELECTROLYTES
A. Eisenberg, S. Saito, and T. Sasada Dec. 1965 25 p refs Presented at the A.C.S. West Coast Reg. Meeting, 1965
(Contract Nonr-233(87))
(TR-11; AD-625331) CFSTI: HC $1.00/MF $0.50

The viscoelastic properties of an inorganic anionic polyphosphate were studied as a function of the counterion. It is shown that as the counterion strength (as expressed, for instance by the ratio of charge to internuclear distance between cation and oxygen anion) increases, the distribution of relaxation times narrows in an approximately linear manner. A small effect of the molecular weight is also observed on the narrowing of the relaxation spectrum, but the latter is much smaller than the former. Author (TAB)

N66-18617# Air Force Systems Command, Wright-Patterson, AFB, Ohio. Air Force Materials Lab.
NONLINEAR RUBBERLIKE VISCOELASTICITY: A MOLECULAR APPROACH Technical Report, Mar. 1964–Mar. 1965
John C. Halpin Oct. 1965 28 p refs
(AFML-TR-65-107; AD-626208) CFSTI: HC $2.00/MF $0.50

The paper presents a treatment of the large nonlinear deformational response of amorphous elastomeric materials. In the development presented the difference between the dynamic and equilibrium tension in a macromolecular chain is expressed as a functional. The functional is expanded in a series analogous to Taylor's series and higher terms are neglected to obtain a linear integral equation for the viscously retarded d response of the network chain. The equation obtained corresponds to a generalized one-dimensional version of Boltzmann's superposition equation on the macroscopic scale. It is then shown that the time dependent response of the molecular chain is independent of the magnitude of the deformation and, consequently, is of the same analytical form whether the deformation is infinitesimal or finite. From this it necessarily follows that there cannot be an inconsistency at finite stress and strain which is not allowed at infinitesimal excitations. Thus the response at

finite excitations can be treated generally by employing the 'generalized' superposition equation and the same techniques which have been utilized in the linear theories. By employing the usual kinetic theory assumptions, equations are developed for the macroscopic response of a well vulcanized rubber. Experimental data obtained in creep, stress relaxation, and dynamic stress-strain for three different elastomers are presented which support the approach outlined. Some consequencies of the theory are discussed. Author (TAB)

N66-18818# Army Foreign Science and Technology Center, Washington, D. C.

MEANS OF LOWERING THE CURING TEMPERATURE OF HEATPROOF ORGANO-SILICON ADHESIVES

A. B. Davydov and Z. G. Ivanova Dec. 1965 10 p refs Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 4, 1965

(FSTC-381-T65-607; AD-626049) CFSTI: HC $1.00/MF $0.50

It was established that additions of pulverized glass to the VK-2 adhesives do not occasion any reduction in its curing temperature. The introduction of glass into the 588 composition in a quantity of 3% (dry weight) reduces the adhesives' curing temperature of 200°C, providing the bonded joints of strength which is practically equal to their strength under optimum bonding conditions. A comparison of the results of the application of the above innumerated catalysts shows that the curing temperature can be reduced to 200°–220°C only with the introduction of Product 18 and potassium acetate into the VK-2 adhesive. A reduction of the curing temperature of the composition 588 down to 200°–220°C can be effected by all investigated additions. The data in Table 2 show that additions of the most active catalyzing components (Product 18, CH_3COOK, silica glass powder) to the VK-2 and 588 compositions do not occasion a negative effect on the thermal stability of the bonded joints. Observation of the changes in the properties of adhesive composition with additions of catalysts showed that TES and silica glass do not have any effect on the stability of the adhesive composition properties during their storage. Additions of Product 18 and potassium acetate have a catalyzing effect on the composition's 'aging' process; therefore they should be introduced directly before using the adhesive. TAB

N66-18839# Barry Controls Div., Barry Wright Corp., Watertown, Mass.

DESIGN GUIDE FOR POLYURETHANE FOAM ISOLATION SYSTEMS

Peter C. Calcaterra Johnsville, Pa., Naval Air Develop. Center, 2 Dec. 1965 124 p *Its* Rept.-101

(Contract N600(19)-59898)

(NADC-AE-6522; AD-625816) CFSTI: HC $4.00/MF $1.00

The advantages of buckling isolators over presently used military standard isolators for the protection of equipment aboard high performance jet aircraft are discussed. The dynamic performance of various foams is compared to the theoretical behavior of buckling isolators based on the experimental results obtained with polyurethane foams. Design guides are presented for the use of polyurethane foams in multifunctional vibration and shock isolation systems based on the experimentally determined dynamic properties of the foam material. Results of tests performed on 1 ATR (B1-D1) size electronic equipment bases, designed and manufactured in accordance with design curves generated for a particular polyester foam, are presented and indicate the suitability of optimizing the use of a particular foam in an isolation system which is to meet specific performance requirements. General manufacturing and quality control techniques applicable to foam isolation system are discussed. Recommendations for further work are made regarding the generation of design curves for other foams and the effect of combined environments on applicability of the design guides. Author (TAB)

N66-18797# ACF Industries, Inc., Albuquerque, N. Mex.

PHYSICAL PROPERTY STUDY OF POLYSTYRENE FOAM (210-050)

T. D. Mc Candless 30 Jun. 1965 32 p refs

(Contract AT(29-1)-1352)

(ACF-10; ACF-412-248) CFSTI: HC $2.00/MF $0.50

Polystyrene foam made by the expanded bead process and having 0.01, 0.05, and 0.10 specific gravities were studied. The following properties were measured: compressive strength and modulus, thermal conductivity, thermal coefficient of expansion, water absorption, humid aging, creep, and stability to thermal cycling. Equipment and test procedures are described. NSA

N66-18886# Bendix Corp., Kansas City, Mo.

A NEW DEVELOPMENT IN POLYURETHANE ELASTOMER PROCESSING WHICH REDUCES CRACK SUSCEPTIBILITY AND BUBBLE ENTRAPMENT

Donald D. Oswald Apr. 1965 23 p Presented at the Natl. Electron. Packaging and Prod. Conf., Long Beach, Calif.

(Contract AT(29-1)-613)

(BDX-613-70; Conf-650608-1) CFSTI: HC $1.00/MF $0.50

A brush and test tube method was used to evaluate the feasibility of degassing polyurethane prepolymer. The test samples provided positive results that the crack susceptibility of polyurethane elastomers was greatly reduced as a result of degassing. Also, the samples of degassed material indicated a definite reduction in the number of trapped bubbles. Correlating the results tends to substantiate the theory that crack tendency and bubble entrapment are related. Comparing typical physical characteristics of elastomer samples, made from degassed and non-degassed prepolymer, gives additional verification to the relationship. The change in tensile strength is the most notable; values as high as 7000 psi have been measured. The manufacturing departments, using polyurethane prepolymer for encapsulation of electrical and electronic assemblies, have noted a definite decrease in scrap (due to bubbles and cracks) since introduction of degassed material. Assemblies that were difficult to encapsulate under a vacuum, because of problems other than voids, can not be encapsulated at atmospheric conditions and still stay within the void size tolerances. Author (NSA)

N66-18943# Oak Ridge National Lab., Tenn.

STUDIES ON EFFECTS OF DEPOSITION CONDITIONS AND HEAT TREATMENT ON THE PROPERTIES OF PYROLYTIC CARBON

J. Young Chang (M.S. Thesis—Tennessee Univ.) Mar. 1965 90 p refs

(Contract W-7405-ENG-26)

(ORNL-3764) CFSTI: HC $3.00/MF $0.75

A study was made of the deposition of pyrolytic carbon from methane gas on direct resistance-heated graphite substrates; the deposits were characterized by means of density, crystallite size, preferred orientation and magnetic susceptibility measurements, and by microstructure studies. The effect of deposition conditions and heat treatment were evaluated in terms of anisotropy factors derived either directly from experimental susceptibility data or indirectly through calculation from other measurements. Deposits up to one millimeter thick were formed over the temperature range 1400 to 2400° C with subsequent heat treatment conducted at 2620° C for times up to

360 minutes on material deposited at 2200° C. All deposits had a columnar, cone-shaped grain structure perpendicular to the deposition surface. The crystallite size, degree of preferred orientation, and density increased and the unit cell height decreased with increasing deposition temperature and heat-treatment time. Evaluation of a diamagnetic susceptibility anisotropy factor, as the ratio of the diamagnetic susceptibility in the direction perpendicular to the deposition plane to the value measured in the plane, showed an increase in the value of this ratio for pyrolytic carbon deposited at progressively higher temperatures and heat treated for longer times. When the value of this direct experimental factor was compared to several calculated factors from X-ray and single-crystal susceptibility values, it was found that the calculated values were too high in every case involving as-deposited material. This behavior was interpreted as indicating that the calculations should not be made, assuming that single-crystal values for the susceptibility are correct, but rather that values characteristic of the state of imperfection of the individual crystallites in the deposit should be used. Since these data were not available, a reverse calculation was made to determine the ratio of the diamagnetic susceptibility in the c-plane to that perpendicular to the c-plane of the crystallites of each deposit. This calculated ratio was considerably higher than calculated from data for the best single crystals but did decrease toward the single-crystal value as the deposition temperature was increased. Author (NSA)

N66-18969 Joint Publications Research Service, Washington, D. C.

STRUCTURE AND PROPERTIES OF CRYSTALLINE GRAFT POLYMERS

Han-Min Tseng *In its* Transl. on Communist China's Sci. and Technol., No. 286 8 Feb. 1966 p 47–81 refs (See N66-18966 09-06) CFSTI: $3.00

The relationship between the collective-molecular structure and the specific characteristics of various crystalline grafted polymer compounds was studied. Investigated were grafted polymers with main chain crystallization as well as grafted polymers with crystallized side chains. It was found that connections of amorphous and crystallization polymers with grafted polymers resulted in synthetic materials with specific properties. Based on its physical–chemical structure, the grafted polymer sometimes included characteristics of the original homogeneous polymer as well as some new properties. G.G.

N66-19095# Joint Publications Research Service, Washington, D. C.

SOVIET STUDIES IN METALLURGY

3 Mar. 1966 24 p refs Transl. into ENGLISH from Russian (JPRS-34373; TT-66-30813) CFSTI: $1.00

CONTENTS:

1. STRUCTURE OF VARIOUS MODIFICATIONS OF PYROLYTIC CARBON A. S. Fialkov, A. I. Baver, B. N. Smirnov, M. I. Chaykun, N. M. Sidorov et al p 1–7 refs (See N66-19096 09-18)

2. MECHANISM OF THE POLYMORPHIC TRANSFORMATION OF GRAPHITE INTO DIAMOND L. F. Vereshchagin, Ya. A. Kalashnikov, Ye. M. Feklichev, I. V. Nikol'skaya, and L. M. Tikhomirova p 8–13 refs (See N66-19097 09-18)

3. SPECIFIC HEAT OF GRAPHITE AT TEMPERATURES FROM 1750 TO 2850 DEGREES K Ya. A. Kraftmakher and V. O. Shestopal p 14–18 refs (See N66-19098 09-18)

N66-19096 Joint Publications Research Service, Washington, D. C.

STRUCTURE OF VARIOUS MODIFICATIONS OF PYROLYTIC CARBON

A. S. Fialkov, A. I. Baver, B. N. Smirnov, M. I. Chaykun, N. M. Sidorov et al *In its* Soviet Studies in Metallurgy 3 Mar. 1966 p 1–7 refs Transl. into ENGLISH from Zh. Strukt. Khim. (Moscow), v. 6, no. 1, Jan.–Feb. 1965 p 66–69 (See N66-19095 09-18) CFSTI: $1.00

The structure of various modifications of pyrolytic carbon is discussed based on electron microscopy, X-ray structural, and microdiffraction analyses. Interface regions were found in pyrolytic carbon which determine its structural anisotropy. Heat treatment of pyrolytic carbon at a temperature above 3000°K formed blocks of mosaic substructure causing reduced azimuthal disorientation of carbon obtained at a temperature above 2000°K in a vacuum, with a structure corresponding to that of natural graphite made amorphous. Conditions for obtaining pyrolytic carbon are changed, depending upon the method of heating the precipitation surface, the atmosphere of pyrolysis, and the form of hydrocarbon used. R.N.A.

N66-19097 Joint Publications Research Service, Washington, D. C.

MECHANISM OF THE POLYMORPHIC TRANSFORMATION OF GRAPHITE INTO DIAMOND

L. F. Vereshchagin, Ya. A. Kalashnikov, Ye. M. Feklichev, I. V. Nikol'skaya, and L. M. Tikhomirova *In its* Soviet Studies in Metallurgy 3 Mar. 1966 p 8–13 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 162, no. 5, 1965 p 1027–1029 (See N66-19095 09-18) CFSTI: $1.00

This paper discusses the mechanisms involved in the polymorphic transformation of graphite into diamonds at high pressure and high temperature. Three methods are examined: crystallization of diamond from melted graphite without a catalyst, crystallization of diamond from a solution of graphite in a melted metal catalyst, and transformation of graphite lattice into diamond lattice in a solid state. R.N.A.

N66-19098 Joint Publications Research Service, Washington, D. C.

SPECIFIC HEAT OF GRAPHITE AT TEMPERATURES FROM 1750 TO 2850 DEGREES K

Ya. A. Kraftmakher and V. O. Shestopal *In its* Soviet Studies in Metallurgy 3 Mar. 1966 p 14–18 refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, Jul.–Aug. 1965 p 170–171 (See N66-19095 09-18) CFSTI: $1.00

This paper presents the results of specific heat measurements of graphite in the temperature range from 1750° to 2850°K by the modulation method using color pyrometry. The procedures, formulations, and instrumentation used are discussed along with the graphical results. R.N.A.

N66-19201# Naval Ordnance Lab., White Oak, Md.

THE THERMAL AND ABLATIVE DEGRADATION OF SOME EPOXY RESINS CURED WITH METHYL BICYCLO(2.2.1) HEPTENE-2,3-DICARBOXYLIC ANHYDRIDE (NMA)

Gerald J. Fleming Dec. 1965 65 p refs (NOLTR-65-101; AD-475864)

The unusual two-step thermal degradation mechanism of epoxy resins cured with methyl bicyclo(2.2.1)heptene-2,3-dicarboxylic anhydride (NMA) was of NMA on the final epoxy system's chemical composition, crosslink density, thermal and ablative performance, and mechanism of degradation. Two mechanisms were elucidated for the initiation of thermal degradation of NMA cured epoxy resins. One, an acid-initiated

mechanism which results in a splitting out of NMA from the resin structure, is operative up to 350°C. The other, a reverse Diels-Alder mechanism, is operative from 350°C and higher, especially under ablative conditions. Author (TAB)

N66-19245# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW ANTIFRICTION AND CHEMICALLY STABLE MATERIALS

S. N. Ganz and V. B. Parkhomenko 1 Dec. 1965 15 p Transl. into ENGLISH from Khim. Prom. Nauk Tekhn. Zb. (Kiev), no. 4, 1963 p 20–24

(FTD-TT-65-857/1+2+4; AD-625092) CFSTI: HC $1.00/MF $0.50

A description is given of new types of antifriction and chemically stable materials, manufactured on the basis of fluoroplast-4 (a polytetrafludroethylene), where molybdenum disulfide, boron nitride, barium sulfuric acid, colloidal graphite type S-1, ground coke, pure anhydrous aluminum oxide and gas channel soot were used as fillers. These materials can be used in role of self-greasing piston rings, slide bearings, packing elements, etc. Their application will offer the possibility of replacing stainless steel, pure aluminum, antichlor and other deficit and high cost materials in chemical apparatus and machine construction. Author (TAB)

N66-19385# Dayton Univ., Ohio. Research Inst.

FRACTURE PROPERTIES OF CARBOXYLIC RUBBERS

John C. Halpin and F. Bueche Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1965 25 p refs

(Contract AF 33(657)-10688)

(AFML-TR-65-108; AD-626929) CFSTI: HC $1.00/MF $0.50

Rupture properties of sulfur and zinc oxide vulcanizates of a carboxylic rubber were experimentally determined. When the logarithm of the strength at break is plotted against the logarithm of the strain at break, failure envelopes are obtained for the two vulcanizates which diverge at long times or high temperatures. As a consequence of this experimental fact it is apparent that while there exists a failure envelope which uniquely describes a given viscoelastic system there is no general shape of the failure envelope representative of all the rupture properties of an elastomer throughout all degrees of vulcanization. It is shown that the molecular fracture theory of Bueche and Halpin provides a quantitative basis for the analysis of the strength properties of elastomers through a wide range of vulcanizate quality, provided the specific character of the network structure is taken into account. It is suggested that the so-called 'unique' strength properties of metal oxide vulcanizates are in reality a natural reflection of a sparse network crosslinkage concentration. Author (TAB)

N66-19438# Melpar, Inc., Falls Church, Va.

FRACTURE OF GYPSUM PLASTERS AND CEMENT MORTARS BY DYNAMIC LOADING Technical Report, 8 Jun. 1964–1 Jul. 1965

Charles W. Martin Kirtland AFB, N. Mex., AFSC, Dec. 1965 80 p refs

(Contract AF 29(601)-6420)

(AFWL-TR-65-140; AD-625458) CFSTI: HC $3.00/MF $0.75

An experimental study was made of influence of strain magnitude and strain duration on dynamic fracture in uniaxial tension of low-strength gypsum plaster, highstrength gypsum plaster, high early strength portland cement mortar, and ordinary portland cement mortar. Dynamic test specimens were circular cylindrical bars with diameters ranging from 0.9 to 1.2 inches and lengths ranging from 18 to 58 inches. Static test specimens 2 inches long were cut from the long bars. A special loading device designed and constructed by Melpar, generated a compressive pulse by longitudinal impact of two metal bars and applied the pulse to one end of the dynamic test specimens. The compressive pulse was reflected at the free end of specimens as a tensile pulse and caused fracture in tension at a section near the middle. Time from zero strain to maximum tensile strain varied from 10 to 35 microseconds, and total duration of tensile strain varied from 20 to 430 microseconds with few exceptions. All materials withstood tensile strains two to three times the static fracture strain for short periods. The straining time required to cause fracture varied with strain magnitude. Author (TAB)

N66-19466# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

EXTENDED USE OF IMPROVED COOLING SYSTEM INHIBITOR—FIELD EVALUATION Interim Report

James H. Conley 3 Dec. 1965 12 p refs

(CCL-190; AD-625928) CFSTI: HC $0.50/MF 0.50

The object of this investigation is to determine if Federal Specification O-I-490a, Corrosion Inhibitor is suitable for use in vehicle cooling systems for extended periods. The improved inhibitor was placed in the vehicle cooling systems with antifreeze compounds meeting Federal Specification O-A-548a, Type I, or commercial materials similar to the Type I. The inhibitor was added at the rate of 1 ounce per 2 quarts of water used in making up the antifreeze solution. Four government vehicles and four private passenger cars were utilized for test. Solutions were checked every three months and if necessary the coolant freezing point, pH value and reserve alkalinity (R.A.) value were adjusted. Data indicate that inspection periods of longer than three months permits the coolant to get out of control. In the event the Army adopts the continued use of antifreeze solutions for two years, the coolant solutions must be checked every three months by technical personnel and adjusted, if necessary, to insure safe continued use. Author (TAB)

N66-19579# Rock Island Arsenal Lab., Ill. Research and Enginering Div.

COMPOSITE PLASTIC FILMS FOR FLEXIBLE, TRANSPARENT PACKAGING Final Report

Lynden W. Lynch Aug. 1965 18 p refs

(RIA-65-1888; AD-624574) CFSTI: HC $1.00/MF $0.50

Five composite films were developed conforming to the MIL-F-22191A, Type 1 requirements at considerably reduced prices. Two are considered to be of a lesser quality with no particular advantages. One, composed of a fluorocarbon and a polyethylene-polyester blend has relatively low physical properties but is rather thin and is exceptionally transparent. Its estimated selling price is $1.00 per square yard. The remaining two films, both composed of fluorocarbon, oriented polypropylene and a polyolefin terpolymer have excellent physical properties. One of these, having a one-mil thickness of fluorocarbon has an MVTR considerably lower than the specification requirement, but it is more expensive ($1.30 per sq yd). The other, having a 1/2 mil fluorocarbon ply has a normal MVTR but is also the most inexpensive ($0.90 per sq yd) of those meeting the specification. Author (TAB)

N66-19697# Foote Mineral Co., Berwyn, Pa.

RADIATION ABSORBING GLASS Final Research Report, Jun. 27, 1964–Oct. 27, 1965

John H. Fishwick 27 Oct. 1965 28 p refs

(Contract DA-36-038-AMC-1729(A))

(R-1778; AD-624874) CFSTI: HC $2.00/MF $0.50

The regions of glass formation in the system Li_2O-B_2O_3-PbO-SiO_2 are determined at the levels of 10, 15, and 20 wt. % Li_2O. Three compositions are selected at the levels of 10, 30, and 50 wt. % PbO as potential glasses for the use in the optical system of a radiation protected pod. The manufacture of these three glasses is described and their properties are reported.
Author (TAB)

N66-19698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SYNTHESIS OF A SEMI-CONDUCTING COMBINATION OF MATERIALS BY A METHOD OF RADIATION OF GASEOUS PHASE INFUSED POLYMERIZATION
A. V. Vlasov et al 26 Nov. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 1, 1964 p 141–142
(FTD-TT-65-1104/1+2+4; AD-624912) CFSTI: HC $1.00/MF $0.50

A method is given for obtaining semiconducting composites with high mechanical durability. Basically the process consists of irradiating glass fibers in the presence of acetylene or acrylonitrile.
TAB

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-18522# Army Missile Command, Huntsville, Ala.
TAMPER: TABLES FOR APPROXIMATION OF MID-POINTS FOR EXPONENTIAL REGRESSION
Dec. 1965 218 p
(AD-625334) CFSTI: HC $6.00/MF $1.25

The tables were designed and developed for a rapid as well as a reliable means of estimating algebraic lot midpoints. They will reduce the computation of a midpoint from 20 minutes to less than 2 minutes. These tables are arrays of ratios that are associated with specific lots and Experience Curve slopes. These ratios represent the percent of the units in the lot that is added to the first unit of the lot to determine the algebraic lot midpoint.
TAB

N66-18533# Mitre Corp., Bedford, Mass.
TRADE-OFFS BETWEEN PARTS OF THE OBJECTIVE FUNCTION OF A LINEAR PROGRAM
Hans C. Joksch Bedford, Mass., AFSC, Electron Systems Div., Dec. 1965 17 p
(Contract AF 19(628)-2390)
(ESD-TR-65-363; W-07454; AD-625736) CFSTI: HC $1.00/MF $0.50

Linear programs whose objective function can be separated into two parts are considered. The following problem is studied: given an optimal solution with respect to the total objective function, how does it have to be modified to change one part of the objective function by a certain amount and affect the other part as little as possible. The construction of an optimal simplex-tableau for the modified problem from the optimal simplex-tableau of the original problem is demonstrated. This can serve as a starting tableau for an ordinary parameteric programming procedure. The marginal exchange ratio for both parts of the objective function and the simplex multipliers for the constraints are derived.
Author (TAB)

N66-18583# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
PROBABILITY INTEGRALS OF THE MULTIVARIATE F DISTRIBUTION, WITH TABLES AND APPLICATIONS
P. R. Krishnaiah and J. V. Armitage Nov. 1965 58 p refs
(ARL-65-236; AD-626931) CFSTI: HC $3.00/MF $0.75

Approximate evaluation of the probability integrals of the central multivariate F distribution and exact evaluation of the probability integrals of the non-central multivariate t^2 distribution are considered in this paper. Also, upper 10%, 5%, 2.5% and 1% points of the central multivariate t^2 distribution are given for the equicorrelated case.
Author (TAB)

N66-18907# Oak Ridge National Lab., Tenn.
SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS WITH THE 1604 SUBROUTINE MATQ
C. W. Nestor, Jr. 15 Jan. 1965 10 p refs
(Contract W-7405-ENG-26)
(ORNL-TN-1037) CFSTI: HC $1.00/MF $0.50

The matrix equations $A\,x=b$, $A^2\,x=Ab$ and $A^3\,x=A^2\,b$ were solved for the solution vector x with a matrix A having elements $a_{ij}=2$ for $i=j$, $a_{ij}=-1$ if $|i-j|=1$ and zero otherwise. The elements of the right hand side vectors b, Ab and $A^2\,b$ were set equal to the corresponding row sums of A, A^2 and A^3, so that the solution vector x in each case would have all $x_i=1$. The order of the matrices ranged from 3 to 30. These calculations were repeated on the 1604 using the Gaussian elimination subroutine MATQ. In general, the maximum error in the solution vector was bout 10^{-3} times the corresponding 7090 result, consistent with the larger number of bits in the 1604 word. In contrast to the 7090 results, close correspondence was observed between the growth of the maximum error and the P condition number for the A^2 and A^3 matrices. The departure of the error behavior of the A matrix from that expected could be interpreted as owing to the discrete nature of the error.
Author (NSA)

N66-19064 Joint Publications Research Service, Washington, D. C.
THE USE OF LINEAR GRAPH THEORY IN SOLVING SYSTEMS OF LINEAR EQUATIONS
E. Ya. Khomenko *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 154–162 (See N66-19046 09-08) CFSTI: $6.00

In the matrix of a system of linear equations, zeros quite often predominate. In this case it would be convenient for purposes of computer memory economy to write only the nonzero elements. The linear graph theory is a convenient instrument in constructing an algorithm for solving systems of linear equations for such a case. The paper concludes that writing of only the nonzero elements with their indices is advantageous, in principle, for any method of solving systems of linear equations, in particular iteration methods. However, since graph conversions of the system do not take place during the course of the calculations, the corresponding program may be constructed with no special difficulties and without calling on theoretical graph interpretations.
R.N.A.

N66-19068 Joint Publications Research Service, Washington, D. C.
THE EQUATION FOR A FIGURE IN NORMAL FORM

I. V. Goncharyuk and V. L. Rvachev *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 189–199 refs (See N66-19046 09-08) CFSTI: $6.00

The R-operations can be used to construct equations for geometrical figures of complex structure. The figure in the plane xOy is considered as a set of points which are common for this plane and some surface $z=f(x,y)$ where $f(x,y)$ is everywhere a defined piecewise differentiable function. The same figure may be obtained as a result of intersection with the plane xOy of various surfaces, for example, $z=f_1(x,y)$ and $x=f_2(x,y)$. Consequently, the equations $f_1(x,y)=0$ and $f_2(x,y)=0$ will be equations of one and the same figure. In solving problems in which a given figure may be encountered, it is possible to avoid this indeterminancy by using the conditions of the problems themselves. The concept of a normal equation is introduced which is unique for each figure, and an algorithm is proposed for constructing the normal equation of an arbitrary figure which with given accuracy may be approximated by a finite number of arcs of circles and segments of straight lines. R.N.A.

N66-19128# Uppsala Univ. (Sweden). Quantum Chemistry Group.
CONCERNING THE ROOTS OF A POLYNOMIAL WHICH CONTAIN A PERTURBATION PARAMETER Scientific Report No. 42
William D. Moseley, Jr. 15 May 1965 9 p refs *Its* Preprint No. 148
(Contract AF 61(052)-701)
(ARL-65-258; AD-625412) CFSTI: HC $1.00/MF $0.50

It is demonstrated that the recurrence algorithm presented by Hollingsworth and Schumacher can be simplified to require knowledge of one root only to evaluate the same root for other values of the parameter in question.
Author (TAB)

N66-19208# Aberdeen Univ. (Scotland).
SPIRALLING IN PLANE RANDOM WALK Special Scientific Report No. 1
E. M. Wright 28 Feb. 1965 16 p refs
(Contract DA-91-591-EUC-3256)
(AD-462109)

A particle is initially at the origin in the (X, Y) plane and each successive step it takes is of unit length and parallel either to the X-axis or to the Y-axis. Its path of n steps is called a spiral if (i) the particle never occupies the same position twice, (ii) any turns the path makes are all counterclockwise or all clockwise and (iii) for many $m>n$, the path can be continued to m steps without violating (i) or (ii). The condition (iii) is designed to exclude a path such as (0,0)-(1,0)-(1,1)-(1,2)-(0,2)-(0,1). A direct 'geometrical' proof is given the number of n-step spirals. A proof by generating functions is added using a well-known identity due to Jacobi.
Author (TAB)

N66-19431# Wisconsin Univ., Madison.
MIXTURE DESIGNS FOR FOUR FACTORS
Normal R. Draper and Willard E. Lawrence (Marquette Univ.) Mar. 1965 25 p refs
(Contract Nonr-1202)
(TR-48; AD-625264) CFSTI: HC $1.00/MF $0.50

Scheffe, in two recent papers (1958, 1963), has given designs for experimenting with mixtures. The basis of these designs is the choice of symmetrical arrangements of points in the factor space and the fitting of carefully chosen models which have exactly as many coefficients as there are data points. The designs are such that some of the experiments do not contain any of one or more ingredients of the mixture. This may or may not be a disadvantage depending on the problem involved. Here an alternate form of design selection is made for the case of mixtures of four factors. It extends the method used in the three factor case in an earlier paper, (Draper and Lawrence, 1965). This involves the premise that, in the absence of specialist knowledge about the form of the true response function, it is desired to fit a response surface equation of first or second order over the factor space of possible mixtures, and experimental runs are needed which, in a certain sense, ensure the best surface fit possible. The principles used in the choice of appropriate designs will be those originally introduced by Box and Draper (1959). Author (TAB)

N66-19444 Research Analysis Corp., Mc Lean, Va.
MODERN UTILITY THEORY: 1940–1970
Peter C. Fishburn Sep. 1965 48 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-160; AD-625047) CFSTI: HC $2.00/MF $0.50

The paper reviews significant developments in utility theory during the past twenty-five years, beginning with the axioms of von Neumann and Morgenstern, and then indicates where additional development may come in the next several years. Axiomatic systems and their main implications for a variety of areas in utility theory are discussed. Included are three approaches to cardinal utility theory (gambles, preference differences, stochastic choice probabilities) and axiomatization of multidimensional utility theory, as well as a number of related topics, including independence, additivity, and stationarity. Ties between axiomatic systems are noted. The paper also presents two related axiomatizations of subjective probability and utility and discusses the relevance of utility theory in decision theory, in both its predictive and prescriptive phases. Author (TAB)

N66-19548 Parke Mathematical Labs., Inc., Carlisle, Mass.
THE ALGEBRA OF BLOCK DIAGRAMS Scientific Report No. 2
John A. Riley Sep. 1965 34 p refs *Its* Rept.-4790-SR-2
(Contract AF 19(628)-4790)
(AFCRL-65-805; AD-625081) CFSTI: HC $2.00/MF $0.50

Free substitution algebras are defined, and their basic properties are derived using the standard techniques of 'universal' algebra. The theory is applied to give a purely algebraic definition of block diagrams (and/or functional nets). A heuristic demonstration is given showing the identity of the present treatment of diagrams with the more geometric approach via labeled graphs. Author (TAB)

N66-19567# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETECTION OF SIGNALS IN A STREAM OF PULSES
R. V. Ambartsumyan 13 May 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Ereven), v. 38, no. 2, 1964 p 71–76
(FTD-TT-65-42/1; AD-615954) CFSTI: HC $1.00/MF $0.50

Formulas are derived for the detection of signals in a stream of pulses. Assumptions are listed and the derivation method is described in detail. A statistical approach is used, with the final result given in the form of conditional probability expressions. C.T.C.

N66-19721# Joint Publications Research Service, Washington, D. C.
ANALYTICAL CONDITIONS OF POSITIVENESS OF A REAL FUNCTION
M. V. Mayerov 4 Mar. 1966 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 4, 1965 p 780–782
(JPRS-34418; TT-66-30858) CFSTI: $1.00

The solution of important problems in the theory of automatic control and the theory of circuits requires the finding of conditions for the positiveness of real functions. Examples of some of these are considered. Also, the properties of real positive functions are considered and the conditions which define the existence of a real function are examined. E.E.B.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-18530# Weather Bureau, Washington, D. C.
THE DIURNAL VARIATION OF THE VECTOR SURFACE WIND AT SEVERAL ICE CAP STATIONS Interim Report, 15 Mar.–15 Sep. 1964
W. L. Schallert [1964] 90 p refs Sponsored by Army (IR-5; AD-625360) CFSTI: HC $3.00/MF $0.75

Diurnal variations of the mean surface wind vector at four stations on the slope of the Greenland ice cap east of Thule are examined for each of twelve consecutive months. In each case all possible harmonic components were calculated. The first (diurnal) harmonic is generally found to be the dominant component though this fact is usually well masked in the 'curves' which the periodic functions are intended to reproduce. Diurnal control of the wind vector is greatest at the highest of the four stations. It appears that the observed diurnal variation of the vector wind is a consequence of a wide variety of atmospheric distrubances whose nature the analysis technique is powerless to describe. Author (TAB)

N66-18592# Illinois State Water Survey, Urbana.
INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF POINT AND AREAL PRECIPITATION BY RADAR ECHO MEASUREMENTS Interim Report, 1 Apr.–30 Sep. 1965
Arthur L. Sims and Eugene A. Mueller [1965] 21 p
(Contract DA-28-043-AMC-00032(E))
(IR-2, AD-626325) CFSTI: HC $1.00/MF $0.50

Analysis procedures and some results are reported of the study to determine an adequate sample size for dropsize studies. The variance of rainfall rates in eight cubic meter samples indicates that 90 percent of the time, an accuracy of ±6 percent may be expected in calculations of rate. The computer programs have been completed for the study of short period rainfall rates. Frequency curves for a small amount of data are presented. Further data processing is continuing. Raindrop data collections and measurements have been completed. Analysis is continuing of the data from New Jersey and North Carolina. Author (TAB)

N66-18600# Army Biological Labs., Fort Detrick, Md.
THE STRUCTURE OF THE FIELDS OF WIND-VELOCITY AND TEMPERATURE IN THE SURFACE LAYER OF THE ATMOSPHERE
A. S. Monin [1965] 30 p Transl. into ENGLISH from Tr. Inst. Fiz. Atmos. (USSR), no. 4, 1962 p 5–20 *Its* Transl. No. 1044
(AD-625621) CFSTI: HC $2.00/MF $0.50

This review considers the currently available theoretical and empirical knowledge concerning the wind velocity and temperature fields in the surface layer of the atmosphere. Attention is concentrated on those characteristics that can be measured directly. The surface layer will denote that lower layer of the atmosphere—having a thickness of a few tens of meters—in which the effect of the Coriolis force can be neglected. TAB

N66-18848# Sandia Corp., Albuquerque, N. Mex.
WIND MEASUREMENT FOR DIGITAL RECORDING
J. W. Reed [1964] 9 p Presented at the Am. Meteorol. Soc. Natl. Conf. on Micrometeorology, Salt Lake City, 13–16 Oct. 1964
(Contract AT(29-1)-789)
(SC-TM-8-62(51); Conf-789-3) CFSTI: HC $1.00/MF $0.50

Vector wind data observed in polar coordinates, which are to be transformed into Cartesian coordinates, are treated to give more accuracy after round-off than is obtained by uniformly dividing the quadrant into angular segments for which sine and cosine are computed. The oscillating nature of round-off errors in computing trigonometric functions must be considered in designing digital encoding systems. An optimized five binary digit transmission system is shown, which will report Cartesian component winds, accurate to 8%, when activated by a digital wind speed sensor. Author (NSA)

N66-19140# Budd Co., McLean, Va. Information Sciences Center.
STUDY OF CLOUD PATTERNS AS SEEN BY METEOROLOGICAL SATELLITES, PHASE 2 Final Report, Feb. 1, 1965–Jan. 31, 1966
James N. Orton 31 Jan. 1966 248 p refs
(Contract NAS5-9551)
(NASA-CR-70826) CFSTI: HC $6.00/MF $1.50 CSCL 04B

A series of pictorial data processing programs were developed for the interpretation of cloud cover photographs. Based on geometric cloud properties, a program was written to subdivide a two brightness level meteorological picture into solid cloud, solid noncloud, and broken regions. Good correlations were obtained in a comparison of human and computer annotation of TIROS pictures. This program was integrated as a subroutine into a second which was constructed to plot solid regions and brokenness contours on digital pictures of two or more brightness levels, and also to delineate and analyze meteorological pictures. A third program was written for the extraction of pattern structures from meteorological pictures. Descriptions are included of utility programs and other special subroutines which are used in processing. D.T.

N66-19229# Travelers Research Center, Inc., Hartford, Conn.
TERMINAL WEATHER PREDICTION TECHNIQUES Final Report, 1 Oct. 1964–30 Sep. 1965
Russell G. Harris and James E. Mac Monegle Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1965 37 p refs Prepared for United Aircraft Corp., East Hartford, Conn. *Its* Rept.-7463-193
(Contract AF 19(628)-3437)
(ESD-TR-65-477; AD-625094) CFSTI: HC $2.00/MF $0.50

Regression equations were applied to hemispheric and 24 and 48 hr prognostic charts produced by the Global Weather

Central's 6 level dynamical model to obtain diagnostic and predicted total-cloud-amount patterns. The equations were derived in previous research to express total-cloud amount as a function of parameters defined by concomitant 500, 700, and 1000 mb height fields. The total-cloud-amount patterns resulting from the use of these equations in this study were verified by comparing them to total-cloud-amount nephanalyses constructed at the Global Weather Central. The diagnostic skill previously shown by the equations on U.S. station data was maintained over other dense-data mid-latitude areas of the hemisphere. Skill measures were lower when sparse-data (i.e., oceanic) regions were included in the test areas. This deterioration is ascribed to poorer definition of the upper-level predictor fields, or nephanalysis inaccuracies, or both, in these regions. The mid-latitutde diagnostic skill of the equations deteriorated about 30 percent when they were applied to 24 hr prognoses, and from 50 to 70 percent at 48 hours. The equations showed little or no skill in tropical or subtropical latitudes, probably because of the effect of advective predictor parameters based on geostrophic assumptions. Author (TAB)

N66-19238# Pennsylvania State Univ., University Park.
INITIALIZATION OF PRIMITIVE-EQUATION MODELS FOR NUMERICAL WEATHER PREDICTIONS, PART I Final Report, 22 Mar. 1960–31 Dec. 1963
Warren M. Washington Dec. 1964 96 p refs
(Contract AF 19(604)-7261)
(AFCRL-64-1005, Pt. I; AD-625348) CFSTI: HC $3.00/MF $0.75

Numerical weather prediction models of the primitive equation type generate spurious gravity-inertial waves, detrimental to the forecast, if the initial wind and height fields are not in proper balance. In this thesis a new method of obtaining balanced initial fields is developed and demonstrated. The method uses calculus of variations to blend the observed wind and height information to yield an analyzed wind stream function through the use of wind vorticity and two forms of the balance equation. The contribution of the observed winds and heights to the analyzed stream function varies with wave length in a prescribed manner. This analyzed stream function is inserted into a complete form of the balance equation which is then solved for a new height field. With the analyzed stream function and new height fields some form of the ω-equation can be solved. The particular form of the ω-equation used depends upon the type of forecasting model. From ω and/or divergence the velocity potential can be solved. Finally, from the stream function and velocity potential fields a new wind field is computed. The new wind and height fields constitute balanced initial data for primitive equation numerical weather prediction models. Author (TAB)

N66-19422# Brown Univ., Providence, R. I.
EXTENSIONS TO THEORY OF TIME SERIES ANALYSIS Quarterly Report, Aug. 1–Oct. 31, 1965
Walter Freiberger 31 Oct. 1965 12 p
(Contract DA-28-043-AMC-00183(E))
(QR-1; AD-626594) CFSTI: HC $1.00/MF $0.50

A discrete time stochastic meterological model based on the presence of weather regimes is discussed. TAB

N66-19467# Woods Hole Oceanographic Institution, Mass.
HEAT FLUX AND SURFACE STRESS ON AND NEAR AN ISLAND IN THE TRADE WIND REGION Sixth Interim Progress Report, 15 Jun.–15 Sep. 1965
E. B. Kraus [1965] 20 p
(Contract DA-36-039-SC-90784)
(Rept.-6; AD-625180) CFSTI: HC $1.00/MF $0.50

The present state of work under the contract is reviewed. It is then shown that the drag coefficient over water is likely to be a function of fetch and wind duration. Observational data are analyzed to specify this relationship. The boundary layer over water is discussed. A double viscous sublayer characterizes the existing regime. Boundary layer separation appears to be a relatively rare event. The motion field has the character of a smooth flow over large parts of the sea surface. The investigation indicates that spray plays only a minor role in momentum transfer, at least at wind velocities below 10 meters per second. A theory has been established for the time-dependent depth and temperature of the midocean surface layer as a function of the interaction with the atmosphere. Large-scale circulation studies which include the effects of oceans on continent and the effects of seasons, were concluded. They will be resumed in a more sophisticated form at a later stage. Processing of Aruba data continues. Author (TAB)

N66-19473# Travelers Research Center, Inc., Hartford, Conn.
RELATIONSHIPS BETWEEN TROPICAL PRECIPITATION AND KINEMATIC CLOUD MODELS Progress Report No. 8, 15 Feb.–15 Aug. 1965
Geirmundur Arnason and Edward A. Newburg Ft. Monmouth, N. J., Army Electron. Command, Jan. 1966 30 p refs *fts*
Rept.-7469-178
(Contract DA-28-043-AMC-01219(E))
(ECOM-01219-8; AD-625689) CFSTI: HC $2.00/MF $0.50

Dry, shallow convection of the roll-type is simulated by means of numerical experiments. Initially, a buoyant bubble near the lower boundary is introduced into neutral surroundings, and the equations of motion, continuity, and thermodynamics are solved numerically to obtain the development in time of the bubble. The computed events show the bubble to rise at an accelerated rate and take the shape of a mushroom with a slim stem and a rounded top which is characterized by a concentration of isotherms. The associated toroidal circulation is that of a narrow intense updraft in the center, and a broad descending flow further out. The pressure field induced by the buoyant bubble is nonhydrostatic and, as such, is of particular interest. It creates inflow extending from the lower boundary to the core of the bubble and accelerates the inflowing air upwards along the stem. The pressure distribution is such that the bubble is exposed to a form drag similar to that on a body moving through a viscous fluid. The evolution of events spans a time period of twenty minutes. Near the end of this period, the bubble is approaching the upper boundary (3000m), the influence of which is becoming noticeable in the results. By then the initial temperature excess of 0.38°C has diminished to 0.13°C as a result of a truncation errors of the finite difference scheme. It is concluded that the computed events are qualitatively in good agreement with observed behavior of dry convection in the atmosphere, and that the finite difference schemes that were used compensate to some degree for the neglected effects of friction and thermal diffusion in the system of physical equations used in the numerical experiment. Author (TAB)

N66-19475# Army Electronics Labs., Fort Monmouth, N. J.
EVALUATION OF METEOROLOGICAL ROCKET WIND SENSORS
Marvin J. Lowenthal Dec. 1964 26 p refs
(ECOM-2537; AD-625388) CFSTI: HC $2.00/MF $0.50

Data from the Meteorological Rocket Network have been used to evaluate the wind sensors from the standpoint of wind speed and wind variability. To investigate the wind variability at any given location, pairs of rocket firings were selected with a time interval of 24 hours. The variations of the wind for this period were examined to determine if there was any significant difference in the values depending on whether the sensors were chaff, chute, or a chaff-chute combination. Analysis of the data indicates that the 24-hour mean vector wind differences are (1) a function of wind speed, and (2) independent of sensor. Author (TAB)

N66-19523*# National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT ACHIEVEMENTS IN SATELLITE METEOROLOGY, 1958–1964
1966 148 p refs
(NASA-SP-96) GPO: HC $0.60; CFSTI: MF $1.00 CSCL 04A

The mission objectives and achievements of the Nimbus and Tiros satellites are discussed, and their television, photographic and radiometric equipment, and the data processing, storage and transmitting facilites are described. The photographic and radiometric data on clouds, snow, ice, temperature, and eddy patterns are given and analyzed. The upper atmospheric sounding rockets and the type of data they acquire are also discussed. A bibliography is included. N. E. N.

N66-19580# Army Electronics Labs., Fort Monmouth, N. J.
IMPROVEMENT IN ACCURACY OF THE ML-419 RADIOSONDE TEMPERATURE ELEMENT FOR HEIGHTS ABOVE 50,000 FEET AND UP TO 150,000 FEET
Ralph W. Armstrong Oct. 1965 62 p refs
(ECOM-2634; AD-624855) CFSTI: HC $3.00/MF $0.75

The problem of radiosonde temperature measurement is discussed, with particular reference to the U.S. Army ML-419 element, and the study of it by Prof. J. H. Shaw of Ohio State University under a U.S. Army contract. An improved reflective coating is proposed; and a method is presented of correcting for radiation error by use of three sensing elements of different radiation absorptivities, but otherwise identical, and identically exposed to convection and to radiation. The method requires accurate reading of the element temperatures, accurate knowledge of the absorption coefficients, close equality of convection heat transfer characteristics, and close equality of exposure to convection and radiation. Other methods of modifying the ML-419 for increased accuracy of air-temperature measurement are discussed. Author (TAB)

N66-19776# Weather Wing (1st), Osan Air Base (Korea).
JANUARY CLIMATE OF SOUTHEAST ASIA
Dec. 1965 66 p *Its* Special Study 105-11/1
(AD-625858) CFSTI: HC $3.00/MF $0.75

January climatic data for the Republic of Vietnam, North Vietnam, Laos, Cambodia, and Thailand are summarized. Separate discussions and charts are given for geographic features, maximum and mean precipitation, mean number of thunderstorm days, mean number of cloudy cold days, visibility, mean number of foggy days, mean maximum and minimum temperature, and mean relative humidity. General discussions are included for winds, special phenomena, and days for air, ground, and sea operations. N.E.N.

N66-19781# American Meteorological Society, Boston, Mass.
THE DIURNAL VARIATION OF THE ABSOLUTE HUMIDITY IN THE ATMOSPHERE SURFACE BOUNDARY LAYER
I. I. Solomatina Bedford, Mass., AFCRL, Sep. 1965 14 p refs Transl. into ENGLISH from Gl. Geofizicheskaia Observ. Tr. (Leningrad), no. 94, 1960 p 156–162
(Contract AF 19(628)-3880)
(T-R-384; AD-625913) CFSTI: HC $1.00/MF $0.50

The first section of this paper contains an analysis of experimental data obtained during special observations at the Koltushi station during the summers of 1957 and 1958. The second contains a theoretical solution of the problem of the diurnal variation of humidity, using the equation of eddy diffusion of water vapor. The eddy coefficient is assumed to be both height- and time-dependent. An example is given of the calculation of the diurnal variation of humidity, and the computational and experimental results are compared. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-18570# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
INERTIAL INSTRUMENT DESIGN VERIFICATION TESTS FOR HIGH-G APPLICATIONS
Richard E. Marshall and Peter J. Palmer Oct. 1965 71 p refs
(Contract AF-04(694)-553)
(E-1866; AD-625042) CFSTI: HC $3.00/MF $0.75

The impact of an inertial guidance system's capability to field calibrate itself stresses the need for instrument testing to demonstrate the instrument's adaptability to positional testing relative to earth's gravity. Corollary tests must prove that instrument coefficients so obtained describe instrument performance over the full extent of variables during operational usage. These tests are called Instrument Design Verification Tests. Test concepts, equipment, and probable physical test limits are presented for single-degree-of-freedom instruments. Author (TAB)

N66-18573# California Univ., Los Angeles. Dept. of Engineering.
OPTIMUM DESIGN AND LINEAR GUIDANCE LAW FORMULATION OF ENTRY VEHICLES FOR GUIDANCE PARAMETERS AND TEMPERATURE ACCUMULATION ALONG OPTIMUM ENTRY TRAJECTORIES
Roger W. Johnson Jan. 1966 143 p refs
(Contract AF 04(694)-826)
(Rept.-66-2; AD-626636) CFSTI: HC $4.00/MF $1.00

The objective of this report is to construct a method to simultaneously derive an optimal approximate closed form passive controller (no energy expenditure) and to optimally design a vehicle capable of earth entry. The simultaneous design of the vehicle controller and the configuration is handled by defining a lumped parameter control which contains all parameters of possible passive control and the constants describing the vehicle configuration. The optimal lumped parameter control is found by the 'neighboring optimal' method from the set of controls which satisfies the entry nonlinear differential equations, the set of initial and final state conditions (two point boundary value problem), and a practical bounded control restraint. A technique is described to further

partition this discrete point set (in time) of lumped optimal controls into the configuration constants and an optimal approximate closed form polynominal controller using Tchebycheff approximation theory. Finally, a closed loop linear guidance law is derived, using this approximate controller, for a typical entry mission. A new independent monotonic variable is substituted (for the most often used variable, time) into this guidance law to reduce guidance errors due to the differences in time interval between the optimal nominal and the neighboring optimal trajectories. Author (TAB)

N66-18986# Federal Aviation Agency, Washington, D. C. Office of International Aviation Affairs.

AUTOMATION IN AIR TRAFFIC CONTROL

[1965] 253 p refs Proc. of 3d Intern. Aviation Res. and Develop. Symp., Atlantic City, 1–3 Nov. 1965

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15. PRIMARY AND SECONDARY RADAR DATA PROCESSING UNDER VARYING CLUTTER CONDITIONS H. Maguire, A. Lewis, and J. A. Lifsey (Burroughs Corp., Detroit) 9 p ref (See N66-19001 09-21)

N66-18987 Eurocontrol Agency, Brussels (Belgium).

DIGITALIZATION OF PRIMARY AND SECONDARY RADAR AND AUTOMATION METHODS AS THEY WILL BE APPLIED TO THE UPPER A.T.C. CENTER FOR BELGIUM, NETHERLANDS AND NORTH GERMANY

R. H. G. Martin *In* FAA Automation in Air Traffic Control [1965] 20 p (See N66-18986 09-21)

Radar is discussed for both monitoring and control of air traffic control (ATC) in the upper airspace allocated to the proposed ATC center for Belgium, Netherlands, and North Germany. Transmission of radar by digital methods is considered for both primary and secondary radar, and it is concluded that work in the secondary radar digitalization field is sufficiently advanced to meet present requirements. Efficient clutter rejection on the primary radar extractors is necessary to maintain line overload at an acceptably low level, however. The use of digitalized secondary radar to initiate automatic tracking and, where possible, automatic identification is outlined. Acquisition, sorting, and distribution of data are discussed, along with decision-making and implementation plans. M.W.R.

N66-18988 Eurocontrol Experimental Centre, Bretigny (France).

ATC SIMULATION AND AUTOMATIC DATA PROCESSING STUDIES—THE ROLE OF THE EUROCONTROL EXPERIMENTAL CENTRE

D. D. Lipman *In* FAA Automation in Air Traffic Control [1965] 17 p (See N66-18986 09-21)

While the Eurocontrol Experimental Center is concerned with flight trials, equipment evaluations, and general research, its main role is to serve as the test center for developing procedures, equipment, and techniques for the upper airspace Air Traffic Control (ATC) installations. Studies in ATC simulation and automatic data processing are considered in terms of a dynamic air traffic control simulator and an EDP system with five basic modules: strip printer, electronic data display, synthetic data display, keyboards, and displayed data designator. M.W.R.

N66-18989 Air Traffic Control Centre, London (England). Air Traffic Control Evaluation Unit.

EVALUATION OF COMPUTER FACILITIES FOR OCEANIC CONTROL

H. Cherry *In* FAA Automation in Air Traffic Control [1965] 10 p (See N66-18986 09-21)

The role of the United Kingdom in the evaluation of automation in North Atlantic air traffic control (ATC) is detailed. An overall system concept has been developed, and a system evaluation using Apollo is being planned. It is expected that such preliminary work will result in the introduction of a computer-oriented system to meet the future operational ATC requirements. Oceanic ATC procedures are discussed, as well as the operational use of Apollo and long-term planning. M.W.R.

N66-18990 Direction de la Navigation Aerienne, Paris (France).

THE APPROACH TO AUTOMATING ATC IN FRANCE

J. Villiers *In* FAA Automation in Air Traffic Control [1965] 27 p (See N66-18986 09-21)

Real time data processing and minimization of manual tasks are discussed for air traffic control, and the methods used in France for introducing automation are presented. The system, to meet both experimental and operational needs, is

arranged into two similar units: the first is intended for operational service and for processing of new functions; the second is used for a back-up system in the event of breakdown of the first, and for programming and experimentation purposes. The configuration consists of IBM 7040 computers connected with 7740 multiplexers and equipped with 1050 peripheral units. M.W.R.

N66-18991 Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.
THE QUESTION: WHAT TO AUTOMATE
Russell L. Biermann *In its* Automation in Air Traffic Control [1965] 10 p (See N66-18986 09-21)

Air traffic control (ATC) functions which are most adaptable to automation are discussed for five basic tasks: (1) relieving the controller of clerical and other non-decision making routine tasks; (2) eliminating or mechanizing coordination tasks, both between controller and controller and between pilot and controller; (3) providing effective pictorial representation of the total traffic situation; (4) detecting potentially hazardous situations caused by human errors and mechanical failures; and (5) assisting controller in decision making processes. It is recommended that implementation of automation be done in phases, and an outline is included for (1) Stage A and (2) Stage B and later tasks. M.W.R.

N66-18992 Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
ATC AUTOMATION IN JAPAN
M. Okada *In* FAA Automation in Air Traffic Control [1965] 20 p (See N66-18986 09-21)

The basic development phase, including simulation studies with actual traffic data, has been completed for a program to implement air traffic control (ATC) automation at the Tokyo area control center. Evolutionary improvement of manual flight progress strip procedures and flexibility for future expansion are incorporated in the plan which is expected to begin operation early in 1968. A real time system with keypacks and displays has been adopted on the ground, with particular emphasis on the design of the man-machine interface. The system is based on a fail/soft concept in case of equipment malfunctions. Actual system layout and operation of the system are discussed. M.W.R.

N66-18993 Bundesanstalt fuer Flugsicherung, Frankfurt am Main (West Germany).
THE PLANNED IMPLEMENTATION OF COMPUTER DIRECTED DISPLAYS IN AIR TRAFFIC CONTROL
R. Maier *In* FAA Automation in Air Traffic Control [1965] 21 p (See N66-18986 09-21)

Display and control equipment has been created to enable the air traffic controller to guarantee safe, expeditious, and economical handling of traffic; and, at the same time, reduce the physical burden placed upon him. These display and control devices are housed at regional control centers. Semiautomatic radar data processing is to be employed until digital equipment becomes available. Presentation of information on the screen, which is based upon a radar-like horizontal picture, is illustrated; and data input into the computer, coordinating efforts with nearby control positions, special displays, and technical features of the display and control equipment are discussed. M.W.R.

N66-18994 Hollandse Signaalapparaten N. V., Hengelo (Netherlands).
A SURVEY OF EXPERIENCES WITH THE SATCO SYSTEM
Jan S. Smit *In* FAA Automation in Air Traffic Control [1965] 5 p (See N66-18986 09-21)

The introduction of automatic strip display is considered for the SATCO program in the Netherlands. A simulation program to replace the paper strips and pencil of the controller with automatic flight progress boards has resulted in the collection of data which can be used to implement automation in air traffic control (ATC). It is stressed that automation of ATC not only means adaption of equipment to ATC, but also requires the adaption of the human operator and his method to the task of automation. M.W.R.

N66-18995 Ministry of Aviation, Pinner (England).
CURRENT PLANS FOR ATC DATA PROCESSING IN THE UNITED KINGDOM
R. E. Cox *In* FAA Automation in Air Traffic Control [1965] 16 p (See N66-18986 09-21)

Radar philosophy, forming of tracks, and track identification are considered for the automation of air traffic control (ATC) data processing. Types of control and control position are discussed for aircraft both on ATC and random routes. Raw radar, processed radar, and switchable displays will be employed; and EDD and radar display will be related by software. Pending traffic, planning probe, flight pattern, and stack displays are also discussed. Various associated problems and system reliability and flexibility are delineated. M.W.R.

N66-18996 Federal Aviation Agency, Washington, D.C. Systems Research and Development Service.
NAS DESIGN CONCEPTS AND SYSTEM CONFIGURATION
Neal A. Blake *In its* Automation in Air Traffic Control [1965] 8 p (See N66-18986 09-21)

Basic design concepts and system configuration are discussed for the air traffic control (ATC) automated subsystems of the National Airspace System. Radar video is digitized at the radar site and transmitted over narrowband telephone channels to ATC facilities, thereby effecting a cost reduction. The system uses a continuous mosaic radar picture covering the center area, and sector boundaries are established that are independent of the coverage pattern of a single radar. The tracking program uses data from several sources in a specified priority pattern; and radar track positions are periodically compared with extrapolated flight plan positions. Routine tasks are allocated to the computer, thereby increasing the effectiveness of the human controller. A computer is used to assist in scheduling and spacing of traffic at major terminal area. The concept of modularity, which provides alternate paths for data in the event of module failure, is used to provide a practical and economical method to achieve system reliability and to accommodate system growth by handling increased traffic and functional loads. M.W.R.

N66-18997 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THE APPLICATION OF AUTOMATION TO THE SOLUTION OF AIR TRAFFIC CONTROL PROBLEMS
Matthew Rosenshine *In* FAA Automation in Air Traffic Control [1965] 17 p refs (See N66-18986 09-21)
(Contract DA-36-039-AMC-03265(E))

A basic model to estimate controller workload in terms of a reference task is modified to determine the number of

aircraft one controller can handle, the number of controllers required, and the effects of system changes on either of the former. Routine and conflict workload time are discussed, an equation is derived for estimating time parameters, and implications of these parameter estimates are considered. Two general ways are presented in which automation may serve to reduce conflict workload time: (1) automation of conflict resolution or (2) elimination of its necessity through automation. The latter approach is considered more promising, even though a certain amount of conflict resolution work will still have to be done because aircraft often deviate considerably from their announced schedules. Some attention is given to an examination of the effects of automatic equipment failure, and equipment redundancy is considered the best protection.
M.W.R.

N66-18998 Direction de la Navigation Aerienne, Paris (France). Centre d'Experimentation.
PROSPECTS AND EXPERIMENTATION OF RADAR DATA HANDLING AT THE ORLY REGIONAL CONTROL CENTER (ORLY ATCC)
Philippe Gufflet *In* FAA Automation in Air Traffic Control [1965] 20 p (See N66-18986 09-21)

Fundamental principles and equipment needed are described for experiments on radar data processing related to air traffic control (ATC). The Orly ATC center is equipped with two primary and one secondary radar which enables the simultaneous handling of three sources of information. Two identical radar video digitizers are in the complex. A block diagram outlines the primary radar extraction logic, and target extraction logic and clutter determination logic are considered. Correlation between primary and secondary radar targets is extracted by employing special synchronization. The IBM 7040 type computer is described, an experimental program for primary radar tracking is presented, and simulation and evaluation programs are discussed.
M.W.R.

N66-19000 Royal Radar Establishment, Malvern (England).
THE REMAINING PROBLEMS OF SURVEILLANCE RADAR AUTO TRACKING
B. W. Oakley *In* FAA Automation in Air Traffic Control [1965] 13 p (See N66-18986 09-21)

Two major problems in automatic tracking from ground surveillance radars are clutter, and occasional absence of plots from tracks within the normal cover area of a single radar; and the latter is discussed in terms of both primary and secondary radar. Overlapping cover, present in most area systems, can largely overcome this absence of plot data and offers other advantages. Among the advantages considered are effective higher data rate, position accuracy improvement, better resolution, and reduction in clutter effects. Among the difficulties of multiple cover are those related to coordinate conversion errors, radar position determination, time, plot weighting, and track smoothing. The role of careful engineering procedures is stressed in overcoming such difficulties, and some attention is given to the cost of multiple cover.
M.W.R.

N66-19001 Burroughs Corp., Detroit, Mich.
PRIMARY AND SECONDARY RADAR DATA PROCESSING UNDER VARYING CLUTTER CONDITIONS
H. Maguire, A. Lewis, and J. A. Lifsey *In* FAA Automation in Air Traffic Control [1965] 9 p ref (See N66-18986 09-21)

A Weather Outline Contour Generator (WOCG) has been developed for use in conjunction with a Radar Video Data Processor (RVDP) to generate weather contours that compare favorably with data obtained by a wideband system, can be reproduced by a set of vectors, and can be used to track-while-scan processing techniques. The WOCG, which provides a means of self-calibration, forms a root mean square estimate of the signal returned from a small area of weather clutter scanned by the radar. From this information, three contours are generated which represent three levels of clutter. Main parts of the WOCG are the (1) Sensitivity in Range Control, (2) Root Mean Square estimator, (3) Self Calibrator, and (4) Contour Generator. An evaluation is currently in progress to determine the full capability of the WOCG.
M.W.R.

N66-19181# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
SATELLITE-NAVIGATION, TRANSIT-SECOR **Bibliography**
H. J. Bos, comp. Oct. 1965 84 p refs
(TDCK-43209) CFSTI: HC $3.00/MF $0.75

This bibliography contains a literature-survey, comprising 125 abstracts of articles, published papers and reports on the subject of satellite-navigation, navigational satellites and geodetic satellites. The available material is presented chronologically in six chapters. A historical review and a summary of technical details is included.
Author

N66-19406# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYTICAL CONSTRUCTION OF THE GUIDANCE SYSTEM OF ROCKETS
A. S. Galiullin 1 Dec. 1965 13 p refs Transl. into ENGLISH from Tr. Inst. Teor. Mekhan. (Moscow), v. 1, no. 1, 1963 p 56–63
(FTD-TT-65-839/1+2; AD-625093) CFSTI: HC $1.00/MF $0.50

The equations of motion of a guided rocket in a vertical plane are given and the equations which will ensure the motion along a given optimal and stable program are derived.
E.E.B.

N66-19413# Naval Research Lab., Washington, D. C.
DISPERSION OF FREQUENCIES IN THE OMEGA NAVIGATION SYSTEM **Interim Report**
J. W. Brogden and A. N. Duckworth 8 Nov. 1965 17 p ref
(NRL-MR-1661; AD-626385) CFSTI: HC $1.00/MF $0.50

It has been proposed to solve the lane identification problem in the Omega navigation system by the transmission of signals at two or more frequencies to produce beat frequencies. A frequency of 13.6 kilo-Hertz (kHz) will be used with the basic 10.2 kHz transmissions to obtain a three-to-one increase in the width of the ambiguities. The phase velocities of waves at 10.2 kHz and 13.6 kHz are not the same, so a four-to-three relationship of wave lengths will not exist and correction factors will be required to obtain lane identification. Observations were made in an aircraft flying from the transmitting stations out to ranges of 4000 miles. The results show that calculated differences in velocity of propagation will be accurate enough to obtain reliable lane identification. The necessary corrections could be provided for the navigator in the form of simple tables.
Author (TAB)

N66-19452*# General Dynamics/Convair, San Diego, Calif.
A STUDY OF VARIOUS ANALYTICAL TECHNIQUES FOR THE INFLIGHT COMPENSATION OF GYRO DRIFT RATES

F. I. Backus 31 May 1965 28 p ref
(Contract NAS3-3232)
(NASA-CR-54574; GD/C-BTD65-091) CFSTI: HC $2.00/MF $0.50 CSCL 17G

Four proposed methods to eliminate inflight gyro torquing for gyro drift compensation were examined for equation accuracy and airborne-computer programming requirements. The results in terms of inflight-storage and compute-cycle penalties show that the drifted rotating-platform coordinate-system and quasi-linear matrix-transformation methods were best. The accuracy of the latter is limited by initial assumptions; therefore, the drifted rotating-platform coordinate-system method, being an exact method, was recommended.
Author

N66-19485*# TRW Systems, Redondo Beach, Calif.
ADVANCED CENTAUR EXPLICIT GUIDANCE EQUATION STUDY Final Report
R. P. Davis, R. M. Staley, and J. P. Ivaska 1 Oct. 1965 261 p refs
(Contract NAS3-3231)
(NASA-CR-54609; TRW-4222-6043-K4-000) CFSTI: HC $6.00/MF $1.50 CSCL 17G

The feasibility of using a set of generalized guidance equations to direct a wide variety of future Centaur missions was investigated. Reasons are given why explicit guidance techniques are best suited to the purposes of the generalized guidance. A set of ground rules to define the missions which are considered to fall within the scope of a utility vehicle are presented. Theoretical developments of the recommended equations are given and performance results reported. A set of computer requirements based on these equations is presented and their implications discussed. It was concluded that: (1) It is possible to design a set of equations which perform space tasks, and which can be accommodated by present day advanced flight computers. (2) The performance of these equations is comparable to, and can exceed the performance of, contemporary procedures. (3) The current Centaur computer is not adequate to handle the requirement of an advanced set of equations, but might handle a version of equations which had a reduced mission accomplishment capability.
N.E.N.

N66-19527*# Pennsylvania Univ., Philadelphia. Graduate School of Arts and Sciences.
GIMBALLESS INERTIAL SYSTEMS FOR SPACE NAVIGATION
Antonios Grammatikos (Ph.D. Thesis) 28 Jul. 1965 212 p refs
(Grant NGR-39-010-029)
(NASA-CR-71089) CFSTI: HC $6.00/MF $1.25 CSCL 17G

Two types of gimballess inertial systems for space navigations are studied: determining the attitude of a spacecraft from linear accelerometer measurements only, and error damping in the inherently unstable mechanization of the navigation equations in the inertial reference frame. Vehicular attitude can be determined from linear accelerometer measurements by properly placing an adequate number of accelerometers inside the vehicle in an arrangement termed accelerometer scheme. Five schemes of 12, 9, 8, 7, and 6 accelerometers are proposed, studied, and compared. The six accelerometer scheme is considered to be the best. Inertial acceleration projections of the vehicular center of mass along the vehicular coordinate axes can be obtained with all the proposed accelerometer schemes. Mechanization of navigation equations in the inertial frame is most suitable for space navigation and consists of a direction cosine computer and the navigation loop which includes the necessary integrators and a gravity computer for gravity compensation. An error analysis of this mechanization shows that the direction cosine computer errors are sinusoidal whereas the navigation loop errors have sinusoidal and diverging components. To improve system performance, three error damping methods are proposed, studied, and compared.
R.N.A.

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22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-18707# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MELTING OF UO_2 DURING IRRADIATIONS OF SHORT DURATION
A. S. Bain, M. Aragones, and H. Guerrero Aug. 1965 22 p refs
(AECL-2289) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Six elements were irradiated for ten minutes in the Hydraulic Rabbit of NRX. The power ratings were sufficient to cause central melting of the UO_2 fuel. Four of the elements contained 1 volume percent tungsten spheres in the UO_2. When the UO_2 melted, the tungsten spheres sank and settled at the demarcation between the melted and non-melted fuel. From these results it was concluded that in UO_2 irradiated at constant power for ten minutes the limit of melting is the boundary between the central zone and the dense band of UO_2, as observed most easily on fractured cross-sections.
Author (NSA)

N66-18739# Oak Ridge National Lab., Tenn.
AN IRRADIATION EXPERIMENT TO STUDY THE COMPATIBILITY OF BeO WITH GRAPHITE AT 1500°C. PART I: PREIRRADIATION DESCRIPTION AND INITIAL OPERATION
C. A. Brandon Nov. 1965 67 p refs Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-TM-1255) CFSTI: HC $3.00/MF $0.75

An irradiation experiment to determine the inpile compatibility of beryllia with graphite at 1600°C is being conducted in the F-1 core position of the ORR. The irradiation which began on March 14, 1965, is scheduled to be completed in approximately nine months after a fast neutron ($E>.18$ Mev) dose of $\sim 2\times10^{21}$ nvt. The experimental facility and the irradiation capsule design and assembly are described. The detailed results of preirradiation spectrographic, gravimetric, photographic and dimensional analyses are tabulated. The proposed postirradiation examination procedure is outlined. The initial operation, through May 13, 1965, has been at the design conditions.
Author (NSA)

N66-18745# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
BLOOST-5: A COMBINED REACTOR KINETICS-HEAT TRANSFER CODE FOR THE BM-7044

M. Merrill 17 Aug. 1965 29 p refs Submitted for Publication
(Contract AT(04-3)-167)
(GAMD-6644) CFSTI: HC $2.00/MF $0.50

BLOOST-5 is a combined reactor kinetics-heat transfer code written in FORTRAN IV for IBM-7044. It is essentially a combination of two previous codes, and is applicable to problems for which the space-independent form of the reactor kinetics equation is valid. Considerable flexibility in fuel element geometry is possible in the heat transfer subroutines. The program operations and input are described. NSA

N66-18776# Atomic Energy Commission, Idaho Falls, Idaho. Health and Safety Div.
SPERT I DESTRUCTIVE TEST SERIES ENVIRONMENTAL MONITORING AND RESEARCH STUDIES
D. F. Bunch Jan. 1965 83 p refs
(IDO-12039) CFSTI: HC $3.00/MF $0.75

The Spert I Destructive Test Program consists of several test series, each of which is terminated by a short-period excursion in which some limited melting or core damage is obtained. One of the major objectives of the series is to investigate the consequences of reactor accidents. The first test of the Destructive Test Series at the Spert I facility (using a highly enriched, uranium–aluminum plate core) had a nuclear energy release of 31 Mw-sec with a period of 3.2 msec. Gross damage occurred to the core, and water was expelled some 25 meters above the vessel. Only daughters of noble gases (^{91}Sr, ^{91}Y, ^{92}Sr, ^{92}Y, and ^{193}Ba) were detected on downwind air samples by gamma spectrometry. An estimated 3.6×10^4 curies of noble gases were released to the atmosphere as a result of this excursion. This amount represents about 7.2 percent of the noble gases which were produced from the excursion and about 0.7 percent of the total fission product inventory. The second test (using a low enrichment UO_2 pin type core) had a nuclear energy release of 155 Mw-sec with a 2.2 msec period. Only slight damage occurred with two fuel pins being ruptured. The release to the atmosphere was about 540 curies, a release fraction of 350 times less than from the first test. Again only daughters of noble gases were detected. This release was about 0.02 percent of the noble gases and 0.002 percent of the total fission product inventory. The third test (using essentially the same core as the second test) had an energy release of 165 Mw-sec with a 1.55-msec period. About 1900 curies of noble gases were released, about 0.06 percent of that produced and 0.006 percent of the total fission product inventory. Based on minimum detection limits of sampling methods, a maximum of 0.01 percent of the iodines produced from each of these tests could have been released to the atmosphere. The fission products that were released from these tests did not create any hazard to personnel or the environment on or off the National Reactor Testing Station. Data from an extensive film dosimeter system indicated maximum doses of about 15 R gamma and 250 Rad beta, 3 meters from the reactor vessel in the first test. At the same locations, doses were 0.6 R gamma and 1.6 Rad beta from the second test and 1.2 R gamma and 1.3 Rad beta from the third test. Studies were conducted with grass samples as well as fallout plates. The average deposition velocities for the first, second, and third test, respectively, were: grass—0.025, 0.033, and 0.042 m/sec; gummed paper fallouts—0.003, 0.005, and 0.004 m/sec. Author (NSA)

N66-18785# Bettis Atomic Power Lab., Pittsburgh, Pa.
HARMONY: SYSTEM FOR NUCLEAR REACTOR DEPLETION COMPUTATION
R. J. Breen, O. J. Marlowe, and C. J. Pfeifer Jan. 1965 108 p refs
(Contract AT(11-1)-Gen-14)
(WAPD-TM-478) CFSTI: HC $4.00/MF $1.00

The Harmony system consists of an integrated set of computer programs which facilitate the diffusion–depletion calculations required in the design and analysis of nuclear reactors. The system design emphasizes flexibility in order to allow the description of a wide range of problems. The user is able to tailor the system to describe his reactor. This flexibility includes the cross section treatment as well as the number and type of nuclides which can be represented. The initial application has been with two-dimensional spatial programs for x-y and r-z geometries in PDQ-5 and hexagonal geometries in PDQ-6. Author (NSA)

N66-18823# Oak Ridge National Lab., Tenn.
NONDESTRUCTIVE TESTING TECHNIQUES FOR RESEARCH AND PROCESS CONTROL
D. A. Douglas, Jr., R. W. Mc Clung, B. E. Foster, and C. V. Dodd [1965] 27 p refs Presented at Symp. on Non-Destructive Testing in Nucl. Technol., Bucharest
(Contract W-7405-ENG-26)
(CONF-650511-1; ORNL-P-1188) CFSTI: HC $2.00/MF $0.50

Three recent examples of the evolution of nondestructive testing techniques from research to process control are reported. A current fuel element design contains fuel pins filled with vibratorily compacted uranium and thorium oxide powder. A gamma attenuation technique was developed to allow measurement of the homogeneity of fuel loading and was used to aid development of fabrication techniques and equipment. Later an inspection device was built to operate remotely in a hermetically sealed and shielded facility and used for production process control. Another fuel element required fuel plates containing a uranium oxide–aluminum dispersion core with a programmed variation in the fuel loading across the width. A continuous scanning, x-ray attenuation technique was developed and used to measure fuel inhomogeneities and conformity to design contour. The technique assisted the development for both core pressing and plate rolling practices. A system was constructed for rapid automatic evaluation of production fuel plates. Another approach to fuel elements is the use of minute fuel-bearing particles coated with pyrolytic carbon to retain the fission products. Of concern are the core diameter, coating thickness and integrity, and presence of fuel in the coating. Development of micro-radiographic techniques provided a powerful tool to evaluate the many variables in the coating process for optimum fabrication. Further application allows evaluation of the effects of service including heat treatment and in-reactor testing. NSA

N66-18826# Los Alamos Scientific Lab., N. Mex.
GAMMA SCANNING OF LAMPRE FUEL ELEMENTS WITH A NaI ANTICOINCIDENCE SPECTROMETER
Dale M. Holm and William Mort Sanders [Jul. 1964] 4 p
(Contract W-7405-ENG-36)
(LA-DC-7316; CONF-651101-30) CFSTI: HC $1.00/MF $0.50

The fission product distributions in molten Pu fuel capsules are measured using a NaI anticoincidence spectrometer. The fuel elements are moved past the detector by a precision scanner. Both continuous and discrete scans can be carried out. NSA

N66-18828# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
A FAST TEST FOR EXCESSIVE U-235 CONCENTRATIONS IN ENRICHED FUEL ELEMENTS

Alec D. Mc Eachern Mar. 1965 18 p refs
(AECL-2231) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

An improvement to conventional methods of detecting areas of enriched fuel elements containing excessive ^{235}U is described. An instrument was designed to inspect uranium-aluminum alloy fuel for the NRU reactor using the improved method. The method was as precise as conventional methods but much faster. The reduction in testing time depended on the application, but typically could be by a factor of four. Alternatively, the improvement may be used to increase the precision of the test without increasing the testing time. The method may be used when the ^{235}U concentration in selected areas of a fuel element is estimated by measuring the intensity of 184-kev γ rays (from the natural decay of ^{235}U) and when an area is considered acceptable if the measured intensity from it is less than a limiting intensity equivalent to the maximum allowable ^{235}U concentration. If the measured intensity is much less or much greater than the limiting intensity, much less time is required to make this decision than when they are nearly the same. The method described takes advantage of this. Each area is thus inspected only as long as is necessary to make a decision with the required confidence. The average time taken is therefore less than that taken by conventional methods, which inspect each area for a pre-selected time chosen to give the required confidence in the most difficult cases, when the measured and limiting intensities are nearly the same. The method is based on sequential sampling theory. It may also be applied to tests for undesirably low ^{235}U concentrations. Author (NSA)

N66-18845# Phillips Petroleum Co., Idaho Falls, Idaho.
SOME METHODS OF CALCULATION OF THE PARAMETERS IN THE REACTOR KINETICS EQUATIONS
G. E. Putnam Feb. 1965 87 p
(Contract AT(10-1)-205)
(IDO-16983) CFSTI: HC $3.00/MF $1.00

The spatially independent form of the reactor kinetics equations is written in terms of several time-dependent parameters, namely, the reactivity, the delayed neutron fraction, the prompt neutron lifetime, the concentration of the ith species of delayed neutron precursor, and the source. Ways of computing the values of the parameters according to these formulae are described in detail with the emphasis given entirely to methods which utilize practically any of the commonly available reactor computer codes without recourse to the calculation of neutron importance functions. Methods are outlined that lead to an indirect evaluation of the commonly encountered integrals of functions weighted by the importance function: that is, the methods involve no integration. The arbitrariness of the definitions of some of the parameters is discussed and several different but equally valid sets of definitions are given by way of example. The criterion for the consistency of a set of definitions is given. Author (NSA)

N66-18873# Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.
PATHFINDER ATOMIC POWER PLANT. BOILER FUEL ELEMENT DESIGN REPORT
D. A. Patterson, W. J. Severson, D. R. Roberts, and R. H. Klumb 8 Jan. 1965 98 p refs Prepared for Northern States Power Co. and Central Utilities Atomic Power Associates
(Contract AT(11-1)-589)
(ACNP-64016) CFSTI: HC $3.00/MF $0.75

The mechanical design of the boiler fuel element assemblies comprising the first boiler core of the Pathfinder Reactor is described. The design requirements are also given. NSA

N66-18876# Los Alamos Scientific Lab., N. Mex.
PLUTONIUM-CERIUM-COBALT FUEL DEVELOPMENT FOR MOLTEN REACTORS
D. R. Harbur, J. W. Romero, and J. W. Anderson Jan. 1965 26 p refs Presented at the Meeting of the Am. Foundrymen's Soc., Chicago
(Contract W-7405-ENG-36)
(LA-DC-6808; Conf-650506-1) CFSTI: HC $1.00/MF $0.50

The fuel which is under consideration for the molten plutonium reactor concept is a ternary plutonium-cerium-cobalt alloy in which the plutonium content can be varied considerably with only small variations in the melting point. Presently the fuel is prepared as vacuum cast rods, which are loaded into tantalum capsules. Obtaining fine-grained unsegregated castings on a production scale was one of the major problems encountered in the fuel development phase of this reactor program. This problem is discussed and the equipment and procedures developed for casting this fuel are described. Author (NSA)

N66-18909# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
AN INTRODUCTION TO THE ASME UNFIRED PRESSURE VESSEL CODE
C. V. Moore 15 Mar. 1965 44 p refs Presented at the ASME Symp. on Pressure Vessels, Idaho Falls, Idaho, 15 Apr. 1965
(Contract W-31-109-ENG-52)
(CONF-650409-1) CFSTI: HC $2.00/MF $0.50

A general introduction to the ASME Unfired Pressure Vessel Code, primarily from the viewpoint of the designer, is presented. The history of the Code is outlined briefly. The areas of application of the Code are described, and the jurisdictional status of the Code is outlined. The administrative arrangements by which the Code is kept up to date and modified are discussed. The organization of the different sections of the Code are explained and the requirements of the various subsections of the Code are outlined—stressing those portions that are frequently misinterpreted or subject to dispute. Finally, current directions for future development of the Code are sketched. Author (NSA)

N66-19002# European Atomic Energy Community, Brussels (Belgium).
DYNAMICS AND CONTROL OF THE FAST PULSED REACTOR "SORA"
G. P. Caligiuri and H. Wundt Nov. 1965 111 p refs
(EUR-2553.e) CFSTI: HC $4.00/MF $0.75

A detailed description of the dynamic behavior of the reactivity-pulsed research reactor SORA is presented, based on results of a simulation on an analog computer. The periodically pulsed state is treated, as well as disturbances from it. Temperature feedback is considered. A suitable control is designed to keep the reactor stable though it becomes prompt-supercritical fifty times per second. The simulation itself required new combined digital-analog techniques which are equally described. Author

N66-19011# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
THE MEASUREMENT AND INVESTIGATION OF TEMPERATURE DISTRIBUTION IN SODIUM FILLED IRRADIATION CAPSULES
A. L. Sullivan Aug. 1965 38 p refs
(AERE-R-5028)

To derive more accurate thermal data for fuel specimen irradiations in sodium filled capsules, the complex temperature distribution that exists in a capsule during irradiation was simulated, and investigated out-of-pile. Experimental results are presented for up to 3 KW of simulated fissile heat output, and diagrams are shown which indicate that a stable convection current exists when the simulation heater is at power. The results are analyzed for the following specific irradiation parameters: (1) temperature distribution along the specimen surface, (2) fissile heat output (for estimation of specimen burn-up), and a relationship is derived between the stable convection and the temperature distribution in the capsule. Author

N66-19108# Florida Univ., Gainesville. Florida Engineering and Industrial Experiment Station.
NUCLEAR ROCKET PROPULSION
Clayton W. Watson, ed. 1964 979 p refs Notes for the 1962 (NSF) Advanced Subject Matter Inst.

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17. 60,000 MEGAWATT NUCLEAR ROCKET p 952–966 (See N66-19121 09-22)

N66-19109 Florida Univ., Gainesville.
MATERIALS FOR NUCLEAR ROCKET PROPULSION
Frederick N. Rhines *In its* Nucl. Rocket Propulsion 1964 p 60–142 ref (See N66-19106 09-22)

The characteristics of nuclear fuel elements are listed, and the problems involved in materials selection are reviewed. Basic data are given on the properties of uranium, uranium alloys, ceramic and dispersal compounds of uranium, and plutonium. Materials for moderators are rated with respect to their slowing power and moderating ratio, and the structural requirements for solid state moderators are defined. Control element and shielding material requirements are also summarized. The use of graphite as a moderator for nuclear power sources is discussed, with details given on the crystal structure, source vs structure, and the physical, thermal, electrical, and chemical properties. The high-temperature mechanical properties of materials are examined, with emphasis placed on crystal dynamics and the structural defects involved in atom mobility in crystals: the vacancy, and the dislocation. High temperature chemical properties, and low temperature properties are also considered. The mechanical properties of some superalloys, and of commercial alloys of reactive metals and sintered aluminum are tabulated. Problems encountered in various kinds of joining are summarized. M.G.J.

N66-19110 Princeton Univ., N. J.
FUNDAMENTALS OF FLUID MECHANICS FOR NUCLEAR ROCKET APPLICATIONS
Jerry Grey *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 145–245 refs (See N66-19106 09-22)

An Eulerian system is presented for analyzing the control volume, and the laws of conservation of mass, momentum, and energy are applied. This application is based on the statement that the rate at which mass (or momentum or energy) enters the control volume—plus the rate at which it is created in the control volume, minus the rate at which it leaves the control volume—is equal to the time rate of change of that quantity within the control volume. Equations are also derived for determining the one-dimensional nonviscous compressible flow, and flows with viscosity. Heat transfer problems are considered, and the limiting case of heat removal from a porous wall by a gaseous coolant is developed. It is assumed that the surface per unit volume ratio is high enough so that the temperature of the fluid may be considered to be the same as that of the adjacent solid. A general expression for heat transfer in small tubes, in which a finite wall-to-gas temperature difference exists, is derived, and the result is reduced to a specialized expression for the porous medium. Rocket nozzle calculations are also included. M.G.J.

N66-19111 Rocketdyne, Canoga Park, Calif.
HEAT TRANSFER AND FLUID DYNAMIC ASPECTS OF NUCLEAR ROCKET ENGINES
John J. Kalvinskas *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 247–347 refs (See N66-19106 09-22)

Heat transfer and fluid dynamic considerations are developed in line with the principle that major heat transfer in the nuclear rocket engine revolve around the reactor. Basic heat transfer equations are derived for both conduction and convection, including high velocity flow at high wall-to-bulk fluid temperatures. Momentum, energy, and continuity equations are formulated and applied to a flow channel accomplishing thermal energy addition to a compressible fluid. A heat transfer model was constructed to provide for the radial heat transfer across the fuel element, and a finite difference form

of axial integration over the length of the fuel element. In the development of a convective heat transfer limited reactor design, a simplified treatment is considered with incompressible flow equations used. A set of parametric core designs, including power density, core dimensions, and core weights for 15,000, 30,000, and 60,000 MW reactors, is included. M.G.J.

N66-19112 Florida Univ., Gainesville.
REACTOR ANALYSIS
Clayton W. Watson *In its* Nucl. Rocket Propulsion 1964 p 350–425 refs (See N66-19106 09-22)

General problems associated with reactor analysis are assessed, and classified as criticality, neutron distributions in space and energy, control effectiveness, reactor kinetics and stability, long-term time-dependent phenomena, and nuclear safety analysis. Emphasis is placed upon the more fundamental problems of estimating the spatial and energy distribution of neutron populations. Certain specialized formulations of the neutron transport equations are presented, and mathematical approximations for obtaining solutions to these equations are examined. The procedures for Monte Carlo simulation calculations are given, along with several examples. It was pointed out that, as a rough rule of the thumb, Monte Carlo can compete favorably with conventional numerical integration when the dimensionality of the problem exceeds about three or four. M.G.J.

N66-19113 Aerojet-General Corp., Azusa, Calif.
CROSS SECTIONS FOR REACTOR CALCULATIONS
John A. Vreeland *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 428–442 refs (See N66-19106 09-22)

The characteristics of neutron cross sections are described, with light, intermediate, and heavy nuclei considered. The shape of resonance peaks is analyzed, and it was concluded that the magnitude of the peaks vary with energy, the same as the average cross sections do. Problems connected with thermal group cross sections are examined, and a variation of the Boltzmann equation is used to develop a thermal spectrum characteristic of the reactor, or the reactor region. For spectrum-averaged cross sections above thermal, the suggested procedure is to solve the Boltzmann equation in an infinite array to produce a spectrum; the form of the Boltzmann equation generally used is given. M.G.J.

N66-19114 Florida Univ., Gainesville.
REACTOR PHYSICS BACKGROUND FOR NUCLEAR ROCKET APPLICATIONS
John A. Vreeland and Clayton W. Watson *In its* Nucl. Rocket Propulsion 1964 p 443–474 refs (See N66-19106 09-22)

Neutron transport theory and the Boltzmann transport equation is discussed in terms of its significance to nuclear rocket reactor design. Since the analytical content of neutron transport theory is contained in the Boltzmann equation, its solution was approached from several angles. These general approaches included experimental techniques, Monte Carlo methods, and analytical methods. Advantages and disadvantages are covered for each method. Taken as the most feasible approach was the experimental in which physical systems are simulated. But the effectiveness of this method is limited by the cost of reactor experiments and by the fact that information obtained is relevant and reliable only to the extent that the experiment approximates the intended design. As the experiment becomes more specialized its value for alternative studies decrease and the cost of setting the experiment fall more on the particular design being pursued. Some of the more frequently encountered special formulations of the Boltzmann equation are also described and mathematical approximations are presented. C.L.W.

N66-19115 Los Alamos Scientific Lab., N. Mex.
RADIATION ENVIRONMENTAL ANALYSIS: A REFERENCE REACTOR CONCEPT AND A STANDARD OPERATING CYCLE
Glen A. Graves *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 476–613 refs (See N66-19106 09-22)

Utilizing the Kiwi A reactor as the basis for a reference reactor concept and a standard operating cycle, an analysis is made of the radiation environment, shielding, and nuclear safety of rocket propulsion reactors. The analysis covers the fission basis of power and the strength of the radiation sources; radiation dosage units, flux-to-dose relations, and radiation protection criteria; radiation decay strength and reactor dose-distance relationships; shielding, shielding against the radiation heating of liquid hydrogen in vehicle tankage and against the payload gamma dose; space radiation; and reactor accidents and safety. C.L.W.

N66-19116 Florida Univ., Gainesville.
NUCLEAR REACTOR KINETICS AND CONTROL
Robert E. Uhrig *In its* Nucl. Rocket Propulsion 1964 p 616–671 (See N66-19106 09-22)

Attention was directed towards an analysis of those nuclear reactor systems whose characteristic behavior can be described by linear differential equations. The analysis covers functional transformations; determination of system response; Bode diagrams; system stability criteria and methods for determining stability; transfer functions of nuclear reactors; and nuclear reactor control systems. C.L.W.

N66-19117 Miami Univ., Coral Gables, Fla.
FEED SYSTEMS
Alan H. Stenning *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 674–728 refs (See N66-19106 09-22)

Descriptions are given of regenerative and bleed type nuclear reactor feed systems and the advantages and disadvantages of each are assessed. The bleed system features an uncoupled feed system and reactor design which results in high development potential. This type has inherent flexibility because the reactor design can be modified without concern for the feed system. Its most important disadvantages are its decrease in specific impulse and poor turbine-pump matching. The regenerative system has maximized specific impulse and excellent turbine-pump matching, but it is lacking in flexibility and development potential because of the strong intermeshing of the reactor and the feed system. C.L.W.

N66-19118 Space Technology Labs., Inc., Redondo Beach, Calif.
OPERATIONAL CONSIDERATIONS, ADVANCED CONCEPTS AND REACTOR DESIGN TOPICS
Robert W. Bussard *In* Fla. Univ. Nucl. Rocket Propulsion 1964 p 759–907 refs (See N66-19106 09-22)

A study was directed towards the optimization and effective utilization of the available energy in a nuclear propulsion system. Comparisons were made of chemical and nuclear systems. Areas were covered which were concerned with nuclear propulsion system performance in high and low acceleration flight, and in interplanetary space. Propulsion unit performance for heat exchanger propulsion systems was also covered, along with discussions of gaseous vortex reactors, nuclear/electric propulsion, direct conversion reactors, liquid filled reactors, fusion reactors, and reactor design topics. C.L.W.

N66-19119 Florida Univ., Gainesville.
200 MEGAWATT NUCLEAR ROCKET ENGINE DESIGN
In its Nucl. Rocket Propulsion 1964 p 910–938 refs (See N66-19106 09-22)

A description is given of the design and operating mechanisms of a 200 MW nuclear rocket engine which was designed to provide a compact power plant capable of delivering 10,000 pounds of thrust with a specific impulse of 800 seconds. The engine heat exchanger is a fast reactor fueled with a zirconium carbide–uranium carbide mixture and operated at an average power density of 50 MW/ft^3. C.L.W.

N66-19120 Florida Univ., Gainesville.
MISSION ANALYSIS FOR A MANNED FLIGHT TO MARS EMPLOYING A 60,000 MEGAWATT NUCLEAR ENGINE
In its Nucl. Rocket Propulsion 1964 p 939–951 refs (See N66-19106 09-22)

Calculations are made for a manned roundtrip spaceflight to and from Deimos, the outermost moon of Mars. The flight employs a spacecraft utilizing a nuclear heat exchanger reactor, capable of developing 60,000 MW at a specific impulse of 748 seconds. The craft is to depart from a parking orbit around the earth, travel to and land on Deimos, and return to earth. Required velocities, times and mass ratios for a minimum energy expenditure mission, and for a fast transitmission are given. C.L.W.

N66-19121 Florida Univ., Gainesville.
60,000 MEGAWATT NUCLEAR ROCKET
In its Nucl. Rocket Propulsion 1964 p 952–966 (See N66-19106 09-22)

The preliminary design of a 60,000 megawatt reactor for a nuclear rocket is presented, and the gross characteristics of the engine are determined. Nuclear computations were performed, using a one-dimension, multigroup, multiregion, diffusion code. It was assumed that the reactor was unreflected on top and bottom. With a four foot height, the axial buckling was constant for all problems at 0.000662 cm^{-2}. The fuel concentration for a homogeneous mixture of U-235 in graphite with 30 percent void fraction was then computed using a one-dimensional radial calculation. The power and flux distribution in one region cores, and the flux, power, and fuel concentration in three region cores are graphed. The code used for the reactor heat transfer calculations carried out a computation on a single unit cell of specified geometry, assuming that there is no net heat flux across the outer boundary of the cell. The axial nuclear power distribution shows that the profile peaks toward the coolant inlet end of the reactor core more than the normal cosine power profile. Figures also depict the power per channel, centerline temperature, and ΔT vs. outlet temperature; and the temperature profiles for hot channel, and average channel. M.G.J.

N66-19190# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
HIGH TEMPERATURE, SHORT-TERM, COMPATIBILITY OF SOME REFRACTORY METALS WITH THE THERMIONIC CONVERTER FUEL UC.ZrC
J. D. Allinson and J. C. Riviere May 1965 34 p refs
(AERE-R-4764)

Short-term compatibility tests of the thermionic cathode material UC–YrC (equimolar) with the refractory metals tungsten, tantalum, molybdenum, niobium, and rhenium have been carried out, in which the temperature of the carbide-metal couple was raised by short steps until reaction was observed. The tests showed that tungsten, tantalum, and rhenium appeared to be compatible for periods of up to 35 minutes at temperatures near 2100°C, but that molybdenum and niobium both reacted vigorously at temperatures well below 2000°C. These results are shown to be fairly consistent with thermodynamic and with UC refractory metal phase diagram considerations for all the metals except tantalum, whose behavior in the tests is considered anomalous. The preferred materials, on the grounds of compatibility, for the purpose of canning the cathode of a thermionic converter for operation in the region of 2000° C, are therefore tungsten and rhenium. Author

N66-19216# Commissariat a l'Energie Atomique, Grenoble (France).
HYDRODYNAMIC INSTABILITIES WHICH LIMIT THE POWER OF BOILING WATER REACTORS, PART II [INSTABILITIES HYDRODYNAMIQUES LIMITANT LAPUISSANCE DES REACTEURS A EAU BOUILLANTE, VOLUME II]
J. Boure Brussels, EURATOM, Dec. 1965 482 p refs In FRENCH, ENGLISH summary with Appendix
(Contract EURATOM-006-64-1 TEEF)
(EURAEC-1464; EUR-2389.f) CFSTI: HC $7.82/MF $3.00

A bibliographical survey is drawn up on the hydrodynamic oscillations phenomenon. This phenomenon occurs, under certain conditions, in heated channels in which the fluid is allowed to boil (such as nuclear reactor channels). It is shown that an understanding of the mechanism of these oscillations can only be gained by means of very simplified models. Two such models are proposed for two different types of oscillation. Author

N66-19220# Cekmece Nuclear Research Center, Istanbul (Turkey).
ON SECOND ORDER CORRECTION TO THE AVERAGE EXTRAPOLATION LENGTH
E. Inonu 1963 15 p refs
(CNAEM-8) CFSTI: HC $1.00/MF $0.50

A first-order expression for the average extrapolation length in bare thermal reactors was given previously on the basis of a many-group calculation. C. Yalcin extended this calculation to second order and obtained a complicated correction term which does not seem easy to apply. His results are analyzed and simplified here by considering the limit for continuous slowing down. It is shown that the second order correction is of the order of $\bar{d}/\bar{R}$, where $\bar{d}$ is the first order average extrapolation length and R is a length which characterizes the size of the reactor. Author

N66-19515*# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 MATERIALS REPORT FOR JANUARY–JUNE 1965
H. Derow and B. E. Farwell Jul. 1965 83 p refs *Its* Rept.-3038
(Contract NAS5-417)
(NASA-CR-54719) CFSTI: HC $3.00/MF $0.75 CSCL 18N

Investigations were conducted in support of the design, fabrication, and development testing of various SNAP-8 components. Investigation of a mercury forced-convection corrosion loop was continued with the aim of evaluating the corrosion resistance of 9Cr-1Mo alloy steel (the reference mercury-containment material) for 10,000-hour service. Rubidium is being evaluated as an additive to the mercury to promote boiler conditioning. Data were developed in a continued program to evaluate the effect of the SNAP-8 operating environment on 9Cr-1Mo steel. Author

N66-19533*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
TRANSIENT TWO-PHASE HEAT TRANSFER AND FLOW CHARACTERISTICS OF LIQUID HYDROGEN

F. A. Campi, J. W. H. Chi, E. A. De Zubay, J. D. Holmgren, and A. M. Vetere Apr. 1963 89 p refs Prepared for NASA (NASA-CR-71087; WANL-TNR-102) CFSTI: HC $3.00/MF $0.75 CSCL 18L

This report summarizes the initial phase of a program designed to evaluate transient two-phase heat transfer and flow characteristics of hydrogen as an integral part of the NERVA reactor requirement. A hydrogen facility and cryogenic laboratory was built, and experiments were performed to obtain the desired data. The experimental program included studies of single phase heat transfer, two-phase flow, and forced convection transient boiling heat transfer. The investigations were made with cold gaseous and liquid hydrogen flowing through horizontal test sections over a range of conditions. Cool-down temperature, cool-down time, single phase heat transfer coefficients, transient two-phase flow characteristics, and two-phase heat transfer coefficients are presented. It has been shown that, in the film boiling and transitional regimes, thermodynamic equilibrium cannot exist between the vapor and the liquid. The mechanisms of two-phase flow during cool-down has been discussed in detail, and a two-phase flow model has been postulated.

Author

N66-19624# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

LATTICE MEASUREMENTS WITH 19-ELEMENT NATURAL URANIUM METAL ASSEMBLIES. PART I: BUCKLINGS FOR A RANGE OF SPACINGS WITH D_2O AND He COOLANTS

K. J. Serdula and R. E. Green Oct. 1965 91 p refs (AECL-2516) CFSTI: HC $3.00/MF $0.75

Bucklings derived from activation measurements in the ZED-2 reactor are given for 19-element natural uranium metal assemblies. Measurements were made in triangular arrays of 55 assemblies at pitches in the range 20 to 40 cm. "Coolants" used were (1) D_2O of moderator purity, and (2) He to simulate a voided condition. Bucklings obtained with He as coolant are higher than those for D_2O coolant for the pitches investigated.

Author

N66-19681# Massachusetts Inst. of Tech., Cambridge, Mass.

A RADIOISOTOPIC POWER SUPPLY FOR THE SUNBLAZER SPACE PROBE

David R. Perkins (M.S. Thesis) Aug. 1965 74 p refs (Contract AF 33(608)-1249) (AD-624684) CFSTI: HC $3.00/MF $0.75

A preliminary investigation of the application of a radioisotopic power source in conjunction with the Sunblazer space probe of the M.I.T. Center for Space Research resulted in the design of a 12 watt-electrical power source which weighs 5.16 pounds. The fuel consists of 526 grams of PuO_2 dispersed in graphite. The fuel is contained in a capsule made of Haynes-25 Alloy which has been designed to contain the isotope under all possible launch abort conditions. The heat from the isotope is converted to electrical power by passing it through 40 Silicon–Germanium thermoelectric couples. The output of 12 watts is produced at 2.66 volts and an overall efficiency of 5.80%. The radiation of waste heat is accomplished by means of an aluminum radiator which is always directed toward cold space. The probe is oriented by means of solar radiation pressure. TAB

N66-19764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF CONCENTRATION RATIO DISTRIBUTIONS IN A BINARY COMPRESSIBLE VORTEX FLOW

Thomas J. Pivirotto 15 Mar. 1966 54 p refs (Contract NAS7-100) (NASA-CR-71282; JPL-TR-32-808) CFSTI: HC $3.00/MF $0.50 CSCL 18I

A scheme for containing fissionable material in the gas phase in a gaseous-core, nuclear-reactor propulsion system is considered. The results of a referenced analysis of this concept indicate that a rotating annular cloud of highly concentrated fuel gas can be retained in a steady, two-dimensional, potential vortex flow. The primary objective was to experimentally determine whether a real vortex flow can sustain an annular cloud of a high-molecular-weight gas at room temperature and to determine analytically and experimentally how this cloud is influenced by several of the flow parameters. Qualitative agreement between the theoretical radial distributions of the heavy to light gas mass density ratio and the measured distributions was found. In addition, the maximum enrichment factor was found experimentally to increase as the heavy gas mass flow rate was decreased at each of three hydrogen mass flow rates tested. This behavior of the maximum enrichment factor was also found for the analytical model. From the analysis based on a two-dimensional (no axial velocities) potential vortex flow, a critical light gas mass flow rate, with respect to achieving large maximum enrichment factors, was found.

Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-18543# Harry Diamond Labs., Washington, D. C.

AN ACTIVE OPTICAL DEMONSTRATION DEVICE EXHIBITING RANGE CUTOFF

Gordon D. North 25 Oct. 1965 16 p refs (HDL-TM-65-50; AD-625929) CFSTI: HC $1.00/MF $0.50

A simple active optical device was designed and built to demonstrate the principles of a geometric ranging optical system. The optical system consists of an objective lens and a beam splitter to provide coincidence of the source and detector beams. The depth of the region in which an object can be detected is proportional to the ratio of the height of the source image to the diameter of the lens. The maximum range of the system is proportional to the lens diameter and to the fourth root of the source radiance. The device described has a range of about 4 ft with a 2-in. F 3.5 lens, a GaAs light emitting diode as the source, and a PbS cell detector. Author (TAB)

N66-18551# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THEORY OF THE CONVERSION OF THE FREQUENCY OF LIGHT WAVES BY A CRYSTAL

B. V. Bokut' and A. G. Khatkevich 8 Dec. 1965 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 8, no. 11, 1964 p 713–716 (FTD-TT-65-1078/1+4; AD-625311) CFSTI: HC $1.00/MF $0.50

This work examines all possible polarization waves occurring in a crystal when it is impinged by two light waves of different frequencies, and the electromagnetic heterogeneous harmonic waves generated by them. TAB

N66-18558# Catholic Univ. of America, Washington, D. C.
PULSE CREEPING WAVES IN ACOUSTICS
H. Uberall, R. D. Doolittle, and J. V. Mc Nichols Jun. 1965 36 p refs
(Contract Nonr-2249-(08))
(Rept.-1-65; AD-625793) CFSTI: HC $2.00/MF $0.50

The phenomenon of diffraction of acoustic and electromagnetic waves by finite or semi-finite obstacles has been interpreted, mainly following the classical paper by Franz, in terms of damped waves which, starting out at the boundary of the geometrical shadow, encircle the body any number of times ('creeping waves'). In acoustics, the sound velocity is small enough so that the sound pulses of sufficiently short duration, the individual creeping waves may be followed around the obstacle directly, whereas in the electromagnetic case, only steady-state interference effects can mainly be observed. The present work is a study of the diffraction of plane-wave sound pulses of arbitrary shape, including their geometrical reflection from the vertex, and their propagation on both the shadow and the insonified surface of the body, as well as their observation at large distances. The special example of an infinitely long, acoustically soft circular cylinder of not too small radius is used, but an extension to other simple cases is possible. Author (TAB)

N66-18571# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE RESPONSE OF SELECTED ROCK SPECIMENS TO VACUUM ULTRAVIOLET LIGHT
William Dean Dupee (M.S. Thesis) Aug. 1965 148 p refs
(GSF/MECH-65-43; AD-625393) CFSTI: HC $4.00/MF $1.00

This is a report on an investigation of the reflectance of selected igneous rocks irradiated by light in the spectral range from 550 to 1800 A. The effect of ultraviolet light upon atoms and molecules is discussed, and Maxwell's equations are used in a classical analysis of the optical properties of solids. This analysis shows that the optical properties are functions of the light wave frequency. A one-meter vacuum ultraviolet scanning monochrometer with a capillary discharge type light source was used in irradiating the rock specimens. Commercial helium was used as the source gas. Experimental analysis of the reflectance properties was approached by calculating the intensity ratio of the 584 A line to the 1216 A line and the 1167 A line to the 1304 A line for the reflected light recordings of each rock type. These reflected intensity ratios were then compared to the corresponding intensity ratios for the incident light spectrum. It was found that almost all of the rocks examined tend to exhibit higher reflectivity at shorter wavelengths. Furthermore, it appears that each rock type has a characteristic response related to the chemical composition. Author (TAB)

N66-18574# California Univ., Santa Barbara. Dept. of Physics.
QUANTITATIVE STUDIES BY OPTICAL SPECTROSCOPY OF ENERGY EXCHANGE MECHANISMS IN SIMPLE GASES AND SOLIDS Semiannual Technical Report, Jul. 1, 1965–Jan. 1, 1966
Harold D. Pruett (Ph.D. Thesis) 1 Jan. 1966 143 p refs
(Contract Nonr-4222(01); ARPA Order 125)
(TR-12; AD-626649) CFSTI: HC $4.00/MF $1.00

Free-carrier mobility studies were made in condensed Ne, Ar, Kr, and Xe using a crystal counter technique. Crystal growth methods based on Bridgman's technique were developed to permit growth of solid samples directly between the electrodes. Electron-ion pairs were generated in the materials by means of a Po-210 alpha-particle source which was electrochemically deposited on one electrode of the parallel electrode arrangement. TAB

N66-18589# AVCO Corp., Wilmington, Mass. Research and Development Div.
MIE SCATTERING COEFFICIENTS FOR SELECTED AEROSOL SIZE DISTRIBUTIONS Final Report, 1 Apr. 1964–31 Oct. 1965
Rudolph Penndorf 31 Oct. 1965 21 p refs
(Contract AF 19(628)-4072)
(RAD-TR-65-39; AFCRL-65-836; AD-626228) CFSTI: HC $1.00/MF $0.50

Formulas are derived for volume scattering coefficients applicable to aerosols. Different types of size distribution for the aerosol, such as normal distribution, log-normal distribution, and exponential distribution, are assumed. Nominal results obtained by the author and those published in the literature are given and discussed. The volume scattering coefficients become smooth functions. The size distribution is very wide. Hence, simpler mathematical formulation can be used than those obtained from the exact Mie theory. However, only the number of aerosol particles can be obtained from an evaluation of experimental data, but details of the size distribution cannot be extracted from experimental data. Author (TAB)

N66-18609# Oregon Univ., Eugene. Physics Dept.
CONNECTED DIAGRAM EXPANSION OF TRANSPORT COEFFICIENTS. I: ELECTRON-IMPURITY SYSTEM
Shigeji Fujita Jan. 1966 36 p refs
(Contract Nonr-2771(05))
(TR-6; AD-626277) CFSTI: HC $2.00/MF $0.50

A connected-diagram expansion method is applied in the evaluation of the correlation function formulas for transport coefficients of an electron-impurity system. This method does not utilize any special representation and is applicable whether or not the system is subjected to a time-dependent electric field and whether or not it is subjected to a constant magnetic field. The connection between the correlation function formula and the generalized transport equation of Kohn and Luttinger is clarified. The first density correction to the conventional formula for the static conductivity of a weak coupling system is explicitly formulated in integrals with the assumption of a more realistic distribution of impurities than the usually assumed uniform distribution. The expansion in powers of the impurity density, whose validity may be questioned in the light of recent controversies over the virial expansion of transport coefficients of a classical gas, does not seem to lead to difficulties for weak, short range impurity potentials. The cases of dynamic conductivity and magnetoresistance are discussed in terms of generalized transport equations. Author (TAB)

N66-18634# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
AN INTRODUCTORY THEORETICAL STUDY OF CONSTANT PERMEABILITY MAGNETIC SHIELDING Foundational Research Report
Ronald P. Lepping 23 Nov. 1965 31 p refs
(NADC-AE-6509; AD-624312) CFSTI: HC $2.00/MF $0.50

Some basic concepts of the constant permeability magnetic shielding problem are examined, and useful mathematical expressions for the static magnetic shielding factor, which follow as a natural consequence of the application of Ampere's law to spherically symmetric, isotropic magnetic shells are developed. The magnetic shielding factor is the ratio of the external unperturbed magnetic field (i.e., measured in the absence of the shield) to the shield's internal field. The development is initially carried out for a single-shell shield and then

extended to trilamellar shielding, which is usually more efficient for a given amount of magnetic material. Particular values of shielding factors are calculated for single- and double-shell shields for low permeability magnetic material.
Author (TAB)

N66-18689# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ALGEBRA OF THE CURRENTS AND DISPERSION RELATIONS
A. V. Efremov, V. A. Matveev, A. N. Tavkhelidze, and A. A. Khelashvili 1965 6 p refs
(VINR-E-2329)

It is shown that the results obtained from the algebra of currents and those of the algebra of charges plus the requirement of the local commutativity are equivalent.
Author (NSA)

N66-18725# California Univ., Livermore. Lawrence Radiation Lab.
LATTICE MODELS FOR COOPERATIVE PHENOMENA. I: SURVEY AND COMPARISON OF APPROXIMATE METHODS
Stephen G. Brush and R. Kikuchi (Hughes Res. Labs.) 1 Sep. 1965 47 p refs
(Contract W-7405-ENG-48)
(UCRL-14287) CFSTI: HC $2.00/MF $0.50

Methods for estimating the thermodynamic properties of physico-chemical systems undergoing cooperative phase transitions are discussed. The Lenz-Ising model can be used to represent mixtures, magnets, and gas-liquid systems; in each case, it is assumed that atoms are arranged in a lattice structure, each lattice site being characterized by a two-valued parameter which may represent the type of atom, spin up or down, or atom or hole. The history of the Lenz-Ising model is reviewed, from its original formulation by Wilhelm Lenz in 1920 up to the present time. The following approximate methods are described: quasi-chemical; cluster variation; eigenvalue variation; and periodic boundary conditions. Thermodynamic properties of the simple cubic lattice, predicted by these approximations, were computed and compared with exact values obtained by series expansions and Padé approximant extrapolations. It was concluded that while none of these approximate methods gives accurate results in the neighborhood of the transition temperature or critical point, it is possible to obtain fairly good values of thermodynamic properties at sufficiently high or low temperatures by using the quasi-chemical or cluster-variation methods. Approximately 100 references are cited.
NSA

N66-18746# Johann-Wolfgang-Goethe-Universität. Frankfurt am Main (West Germany). Institut für Kernphysik.
THE OPTICAL PROPERTIES OF TiO_2 AS A REFLECTOR FOR PLASTIC SCINTILLATORS [DIE OPTISCHEN EIGENSCHAFTEN VON TiO_2 ALS REFLEKTOR FUR PLASTISCHE SZINTILLATOREN]
R. Mayer and A. Wensel Jul. 1965 12 p refs In GERMAN; ENGLISH Summary
(IKF-12)

The optical properties of TiO_2 (NE 560) as a reflector for plastic scintillators were studied. The reflector was applied to the plane face of a hemisphere made of lucite which has approximately the same index of refraction as plastic scintillator. The total diffuse reflecting power is 0.876. This value was determined by comparison to a MgO standard. The angular dependence of the reflecting power indicates that TiO_2 behaves as an ideal diffuse reflector only for angles from normal up to 60°. The contribution of regular reflection to total reflection as a function of the angle of incidence was determined using an approximative integration method. Reflection coefficients for regular reflection were calculated using Fresnel's formulas.
Author (NSA)

N66-18810# ACF Industries, Inc., Albuquerque, N. Mex.
ULTRASONIC TESTING
F. W. Jarrett 15 Feb. 1965 17 p Presented at the Golden Gate Section of the Soc. for Nondestructive Testing, San Francisco, 13 Jan. 1965
(Contract AT(29-1)-1352)
(ACF-4; Conf-650109-1) CFSTI: HC $1.00/MF $0.50

A brief survey is presented of the theory, application, equipment, and procedures for ultrasonic inspection. The parameters involved in such inspection are outlined, and its advantages and limitations are described. Criteria are given for successful inspection.
NSA

N66-18814# Los Alamos Scientific Lab., N. Mex.
POLARIZATION ON THE ENERGY BEAM IN INFRARED GRATING SPECTROPHOTOMETERS
Raymond S. George [1963] 32 p refs Submitted for Publication
(Contract W-7405-ENG-36)
(LA-DC-6719) CFSTI: HC $2.00/MF $0.50

An account is given of the polarization occurring within the Perkin-Elmer Model 421 and 521 infrared grating spectrophotometers. It is shown that the use of gratings in these instruments results in considerable polarization of the energy beam. The efficiency curves and the degree of polarization curves for the two components of polarization are given as a function of frequency. The polarization properties of the microsampling unit and the attenuated total reflectance accessory are also investigated.
Author (NSA)

N66-19086# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures in Gases and on Plasma Chemistry.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer (Calif. Univ., Berkeley) and N. Manson (Poitiers Univ.) 31 Dec. 1965 34 p refs Prepared in cooperation with Natl. Bur. of Std.
(Rept.-17) Available from Natl. Bur. of Std., Washington, D. C.

A bibliography is presented on spectroscopy of interest to high temperature chemistry, reactions between gases and condensed phases, and thermodynamics of plasmas.
R.N.A.

N66-19101# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
ADSORPTION PUMPS [LE POMPE AD ADSORBIMENTO]
V. Chimenti 26 Oct. 1965 21 p refs In ITALIAN *Its* Nota Interna No. 294
(LNF-65/38) CFSTI: HC $1.00/MF $0.50

A cryogenic, ultrahigh vacuum pump which is used to evacuate a storage ring is described. Its principle of operation is the force of adhesion between gas molecules and a wall. Wall substances used in the pump are vegetable carbon, zeolite, and titanium.
Transl. by D.T.

N66-19125# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
BEAM OPTICS COMPUTATION FOR PARTICLE TRANSPORT SYSTEMS
M. Bassetti, R. M. Buonanni, and M. Placidi 16 Dec. 1965 31 p refs
(LNF-65/45) CFSTI: HC $2.00/MF $0.50

Computation methods for beam transport systems are presented. The system considered consisted of a succession of bending magnets and quadropole lenses separated by drift spaces. For a given system, the same properties can be obtained through several sets of parameters without changing the essential construction. The solution providing the best compromise between practical requirements was chosen. The sets of parameters fulfilling the channel optical requirements were determined. Each solution was obtained using a computer program which gives the indications necessary for further selection. The program is described in detail and a sample program is included. H.S.W.

N66-19126# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COHERENCE PROPERTIES OF ELECTROMAGNETIC RADIATION

Chih-Chiang Wang 30 Nov. 1965 39 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 5, 1963 p 320–335

(FTD-TT-64-708/1+2+3+4; AD-625038) CFSTI: HC $2.00/MF $0.50

Recent advances are surveyed in research on the coherence properties of light and the concept is discussed of the photon degeneracy and the degree of coherence, which plays an important role in explaining many problems such as interference, beats, intensity fluctuations and so on. Since the processes of radiation occur at random the intensity of beat signal is determined by the correlation of the processes. Since photons are regarded as bosons there will be a corresponding term in the intensity fluctuations. From the experimental results available it appears that all coherent properties of light can be explained in terms of the basic concept of quantum mechanics. Author (TAB)

N66-19144# Cekmece Nuclear Research Center, Istanbul (Turkey).

WIGNER'S METHOD IN QUANTUM STATISTICAL MECHANICS

Kaya Imre, Ercument Ozizmir, and P. F. Zweifel Oct. 1965 44 p refs

(CNAEM-29) CFSTI: HC $2.00/MF $0.50

The Wigner method of transforming the quantum mechanical operators into their phase-space analogues is reviewed with applications to the scattering theory, equilibrium and dynamical state of the many particle systems. Inclusion of exchange effects is discussed. Author

N66-19200# Raytheon Co., Bedford, Mass. Space and Information Systems Div.

OPTICAL RANGE AND RANGE RATE INVESTIGATION Interim Engineering Report, 15 Jul.–15 Oct. 1964 (Addendum)

2 Feb. 1965 23 p refs

(Contract AF 33(657)-11659)

(FR-65-41-2, Addend.; AD-456981)

A series of experiments using visible and infrared lasers for measuring scintillation and phase fluctuation were conducted as part of a program for studying the effects of atmospheric structure on light propagation. A modulated interferometer was used to produce doppler beats between a reference beam and one reflected from a plane mirror at a distance. Preliminary results of the phase measurements taken over total light paths of 2 1/2 miles to 14 3/4 miles are presented. Theoretical background equations for the structure of atmospheric turbulence are given; and the basic arrangement of the optical system configuration is shown by schematic diagram and by photographs. L.S.

N66-19202# Naval Ordnance Lab., White Oak, Md.

INITIATION OF REACTION IN EXPLOSIVES BY SHOCKS

T. PLiddiard, Jr. and S. J. Jacobs Dec. 1965 54 p refs

(NOLTR-64-53; AD-474166)

Several solid high explosives are subjected to shocks of moderate amplitude, 10-50 kb. In general, these shocks are strong enough to cause chemical reaction, but not full detonation. Examples (photographic sequences) are shown of the acceptor response of several explosives at various entering shock pressures (stresses). The stress in the acceptor which just produces detectable reaction is determined from a plot of the break-out time of gaseous products of reaction from the acceptor as a function of the entering stress. The stress at which detonation is just produced in the acceptors is also determined. Threshold values for burning and for detonation also are obtained from graphs of the velocity of the acceptor undergoing chemical reaction as a function of the entering stress. The thresholds for burning and for detonation are compared with the 50% firing stresses obtained with the standardized gaps test. Author (TAB)

N66-19205*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.

MODULATION INDUCING RETRODIRECTIVE OPTICAL SYSTEM (MIROS) FOLLOWON PROGRAM Final Report, 21 Nov. 1964–15 Feb. 1965

D. D. O'Sullivan et al [1965] 66 p refs *Its* Rept.-5039A (Contract NAS5-9764)

(NASA-CR-70731) CFSTI: HC $3.00/MF $0.75 CSCL 20F

This report is the result of a program to study passive modulation of light by light. This report describes materials which are potentially able to generate absorption bands upon optical irradiation and the possibility of using an alkali halide as a passive modulation transfer element. Many organic compounds generate absorption bands upon irradiation. Induced absorption by means of generating free-charge carriers in a photoconductive material is discussed. Uranyl compounds also have been looked into as possible devices. The experimental results of passive modulation using alkali halides indicates that they are not ideal modulation transfer devices. It is concluded that a passive optical modulation transfer can be accomplished at frequencies not exceeding a few megacycles. Power requirements on the optical beams are moderate, on the order of milliwatts. Author

N66-19213# National Aeronautical Lab., Bangalore (India).

A STUDY OF THE HOURLY WIND SPEEDS AT KODAIKANAL FROM THE POINT OF VIEW OF WIND POWER UTILISATION

M. S. Prakasa Rao and S. R. Radhakrishnan Dec. 1964 24 p ref Revised

(TN-WP-17-62) CFSTI: HC $1.00/MF $0.50

The hourly wind speeds at Kodaikanal have been used to estimate the energy extractable from the wind. The number of hours of low winds, the spells of such low winds with different durations and the diurnal variation of the wind are discussed. The annual mean wind speed works out to 11 km.p.h. The annual output of a wind electric generator of 30 sq.m swept area and an overall power coefficient of 12 percent works out to 1,553 kWh. The water pumping capacity of a WP-2 type windmill is 55,850 kl (12,310,000 gallons) per annum or 36,500 gallons per day. Author

N66-19214# Bureau of Mines, Pittsburgh, Pa.

SYMPATHETIC DETONATION OF AMMONIUM NITRATE AND AMMONIUM NITRATE–FUEL OIL

R. W. Van Dolah, F. C. Gibson, and J. N. Murphy 1966 43 p refs

(BM-RI-6746)

An investigation was made of the distances over which sympathetic detonation of ammonium nitrate (AN) and ammonium nitrate–fuel oil (AN-FO) might be expected. Large-scale gap tests used two types of AN-FO donor charges in three sizes with AN, both at ambient and elevated temperatures, and AN-FO acceptor charges. The acceptor charges were instrumented to indicate initiation and to determine detonation velocity. Other electronic techniques for measuring the rate of growth, stability of detonation, and detonation pressures were employed. Air shock and fragment velocities between charges were measured by electronic and photographic methods, and determination of side-on air-blast pressures and impulse duration were made for about half the shots. Separation distances between donor and acceptor were found to be larger than anticipated both for the AN and the AN-FO. With AN-FO acceptors and a 16-gage steel faced donor, one initiation occurred at a separation of 53 feet or nearly 16-charge diameters; with AN, initiation occurred at 4 to 5-1/2-charge diameters. Author

N66-19219# Cekmece Nuclear Research Center, Istanbul (Turkey).

ON THE ALGEBRAIC STRUCTURE OF THE CLUSTER EXPANSIONS IN STATISTICAL MECHANICS

Cahit Arf, Kaya Imre, and Ercument Ozizmir Feb. 1964 36 p refs

(CNAEM-14) CFSTI: HC $2.00/MF $0.50

The partitions of a finite set are regarded as operators which divide this set into parts, and the commutative algebra generated by these operators is developed and studied. Two different representation spaces (one of which is graded) of this algebra are constructed. As application, some properties connected with the cluster expansion of the statistical mechanics are deduced within the context of the present formalism by establishing an operator isomorphy between the representation spaces constructed herein and certain vector spaces generated by the distribution functions. Author

N66-19230*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.

[RESEARCH ACTIVITY CONDUCTED AT ELECTRONIC SCIENCES LABORATORY, USC] Consolidated Semiannual Progress Report No. 2, 1 Apr.–30 Sep. 1965

[1965] 144 p refs

(Grants NGR-05-018-022; NSF GP-3113; AF-AFOSR-76-63; Contracts Nonr-228(34); AT(11-1)-113 et al

(NASA-CR-71244; AD-625471) CFSTI: HC $4.00/MF $1.00

The report summarizes the research activity conducted during the period April 1965–September 1965. Topics include: Solid state (Semiconductors, Magnetism, imperfections in crystals, superconductivity); Applied electromagnetics, acoustics and plasmas (plasmas, radiation and diffraction of electromagnetic waves, scattering from underwater objects, millimeter waves); Information sciences (control systems, information processing and signal detection, hybrid and digital computation, coding theory, optical processing). TAB

N66-19232# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.

INVESTIGATION OF SELF-EXCITED PLANNING VIBRATION AT LARGE WETTED ASPECT RATIO Final Report

Elmo J. Mottard Nov. 1965 33 p refs

(DTMB-2017; AD-625339) CFSTI: HC $2.00/MF $0.50

The effects of beam, sweepback, trim, load, speed, natural frequency, and vibrational direction on the incipience of vibration of planing surfaces with large wetted aspect ratio were investigated. Experimental results are presented in nondimensional form and correlated with results from a semi-empirical analysis. These results lead to the conclusion that the vibration under study was a dynamic instability involving an induced rise of the water surface ahead of the planing surface. Based on the results of the study, means of alleviating the vibration are suggested. Author (TAB)

N66-19383*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.

THE ABSORPTION SPECTRUM OF CALCIUM VAPOR: 1660–2028 Å Scientific Report No. 5

G. H. Newsom Dec. 1965 26 p refs

(Grant NsG-438; Contract Nonr-1866(48))

(NASA-CR-71064; AD-626164) CFSTI: HC $2.00/MF $0.50 CSCL 20 F

The vacuum ultraviolet absorption spectrum of calcium vapor was observed in an attempt to discover transitions to new energy levels. Seven new levels were found between 51,000 and 59,000/cm, three of which are ascribed to the 3d5p, 3d6p, and 5s4p configurations, with the remaining four lines resulting from transitions to 3d4f and 3d5f configurations. The 3d5p 3P (1)o level reported by Ditchburn and Hudson at 52225/cm is now found at 51909/cm. A graph of relative cross-section for photoionization from the ground state of calcium is shown between 1660 Å and the principal series limit. A shock tube was used to observe several transitions to autoionizing levels from excited states. Author (TAB)

N66-19384# Naval Research Lab., Washington, D. C.

CALCULATION OF THE MONOSTATICALLY REFLECTED VELOCITY POTENTIAL IN THE FAR FIELD OF CERTAIN FINITE RIGID BODIES

A. J. Rudgers 3 Dec. 1965 36 p refs

(NRL-6285; AD-626834) CFSTI: HC $2.00/MF $0.50

An existing theory of acoustic reflection, application in the far field and embodying the Kirchoff approximation, is used to calculate the velocity potential of the acoustic wave monostatically reflected from certain rigid bodies. Where possible, a reflection summation formula is applied in these calculations that is written in terms of a few simple geometrical parameters of the reflecting body. The limiting forms of the summation-formula results are found. These forms are identical to results which can be derived according to a well-known reflection integral. A comparison of the approximation of the reflection summation formula to the reflection integral is discussed for certain bodies. General formulae are derived which may be applied to any reflecting object whose surface can be generated by a conic section, or to segments and frustums of such objects. A limitation of calculation schemes based on the summation formula is discussed and illustrated by calculating the velocity potential of the wave reflected from a short, rigid, right-circular cylinder according to the reflection integral. Results of the calculations are discussed in terms of the geometrical parameters employed in the reflection summation formula. Author (TAB)

N66-19417# Miami Univ., Coral Gables, Fla. Radar Meteorological Lab.

STUDY OF LIGHT ATTENUATION UNDER SUBTROPICAL CLIMATIC CONDITIONS, 1 Jul. 1963–30 Nov. 1965

H. W. Hiser, P. E. Normal, and J. D. Hirth Dec. 1965 97 p

(Contract DA-36-039-AMC-0352E)

(Rept.-1; AD-626198) CFSTI: HC $3.00/MF $0.75

This report contains an analyzed sample of attenuation measurements of blue, green, red and infrared light made in the Florida Everglades in the summer quarter of 1964. Data for the other three seasons will be included in the final report. Graphs are presented for: total transmittance versus range, direct transmittance versus range, and the ratio of indirect light intensity versus the direct extinction coefficient

times range. A portion of the report describes the field site, equipment used, and methods of data collection. Several auxiliary graphs give results of Polar Nepholometer measurements of the light scattered from particles in a small volume of air as a function of the angle of incidence and reflection. Author (TAB)

N66-19433# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF AMPLIFYING ELECTROMAGNETIC OSCILLATIONS
I. V. Lebedev 27 Oct. 1965 7 p Transl. into ENGLISH from Russian Patent no. 167223 (Appl. no. 895751/26-25, 20 Apr. 1964) 2 p
(FTD-TT-65-807/1+4; AD-625797) CFSTI: HC $1.00/MF $0.50

A method of amplifying electromagnetic oscillations with the aid of a closed or open electron flux moving in crossed electric and magnetic fields is presented. To improve the coefficient of amplification in connection with high efficiency of the amplifier and a broad band of frequencies one uses a retarding system which works in a mode of positive or negative dispersion in the form of two non-resonance sections not connected with each other or weakly connected by an electromagnetic field. An input UHF signal is passed into the retarding system to assure the fulfilling of the rule of buncher by one of the sections which is the negative electrode. The second section which plays the role of the positive electrode (anode) of the amplifier and serves for selection of the potential energy from the bunched electron flux one arranges parallel to or concentric with the former with the shifting of the impedance surface in the direction of the electron flux movement. The electron flux is injected into the space of interaction at a short distance from the surface of the first section with the aid of a separate electron-optical system. TAB

N66-19445# California Univ., Los Angeles. Dept. of Engineering.
THE PROPAGATION PATH OF A WAVE IN A VARIABLE SPEED OF SOUND MEDIUM OBTAINED BY EMPLOYING FERMAT'S PRINCIPLE
Louis Solomon Nov. 1965 22 p refs
(Contract Nonr-233(62))
(Rept.-65-48; AD-625084)

Fermat's Principle states that a wave will follow a path such that the time taken to move between two points is a minimum. According to this principle, the ray path of a sound wave in a variable speed of sound medium is derived using variational techniques. This leads to an integral which gives the horizontal position of the wave front explicity as a function of the speed of sound variation with vertical distance. Several examples are worked out, including an explanation of the occurrence of sound channels and shadow zones. Further, it is shown that a hyperbolic cosine function closely approximates the actual velocity of sound as a function of depth. Using the hyperbolic cosine approximation, the integral is evaluated giving an explicit formula for a ray path. Author (TAB)

N66-19459*# Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense and Space Center.
MODULATION INDUCING RETRODIRECTIVE OPTICAL SYSTEM (MIROS) FOLLOWON PROGRAM
Washington, NASA, Mar. 1966 66 p refs
(Contract NAS5-9764)
(NASA-CR-408) CFSTI: HC $3.00/MF $0.75 CSCL 20F

This report is the result of a 3-month followon to the MIROS program. These two programs were initiated in order to study passive modulation of light by light. This report describes the results of a research of materials which are potentially able to generate absorption bands upon optical irradiation and the result of an experimental study of the possibility of using an alkali halide as a passive modulation transfer element. A search of the literature has revealed many organic compounds which generate absorption bands upon irradiation. Induced absorption by means of generating free-charge carriers in a photoconductive material is discussed. Uranyl compounds also have been looked into as possible devices. The experimental results of passive modulation using alkali halides indicates that they are not ideal modulation transfer devices. It is concluded that a passive optical modulation transfer can be accomplished at frequencies not exceeding a few megacycles. Power requirements on the optical beams are moderate, on the order of milliwatts. Author

N66-19468# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.
MODAL ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS
Leopold B. Felsen and Nathan Marcuvitz 5 Aug. 1965 70 p refs
(Contract AF 19(628)-4324)
(PIBMRI-1257-65; AFCRL-65-668; AD-625362) CFSTI: HC $300/MF $0.75

After a general discussion of non-harmonic electromagnetic processes from the viewpoint of temporal Fourier (or Laplace) analysis and synthesis, a class of problems is considered for which the transient solution may be recovered in simple form. Included in this category are pulsed point, line and plane wave sources in free space, and in the presence of (a) a dielectric half-space, (b) a perfectly absorbing or perfectly conducting wedge or half plane, and (c) a unidirectionally conducting infinite and semi-infinite screen. Explicit expressions for the transient response, found by a systematic application of the modal procedures discussed in earlier chapters in this sequence, are interpreted in physical terms. Attention is then given to a second class of problems wherein an electric charge moves uniformly along a straight trajectory in various environments. The associated radiation is now of the Cerenkov type, and formulas for the fields as well as the radiated power are given. Author (TAB)

N66-19509*# Minnesota Univ., Minneapolis.
POLARIZATION, DIRECTIONAL DISTRIBUTION, AND OFF-SPECULAR PEAK PHENOMENA IN LIGHT REFLECTED FROM ROUGHENED SURFACES
K. E. Torrance, E. M. Sparrow, and R. C. Birkebak (Ga. Inst. of Tech.) [1965] 38 p refs Prepared in cooperation with Ga. Inst. of Tech.
(Grant NsG-137)
(NASA-CR-71084) CFSTI: HC $2.00/MF $0.50 CSCL 20F

Measurements were made of the plane-polarized components of the reflected radiation as well as of the mixed radiation (containing all components of polarization). The test materials included magnesium oxide ceramic and aluminum coated ground glass, thereby permitting a study of reflection in the presence and in the absence of sub-surface scattering. The angle of incidence was varied from 10° to 87°, while the angle of reflection extended from 0° to 89°. The roughness of the test surfaces ranged from optically smooth to 5.8μ, while the measurements were performed monochromatically at a wavelength of 0.5μ. It is found that a maximum in the distribution of the reflected intensity occurs at reflection angles larger than the specular-ray direction. The contributions of the s- and p-components of polarization to this off-specular peak

are delineated. The degree of polarization imparted by reflection at surfaces of varying roughness is also investigated. It is shown that the absence or presence of sub-surface scattering is an important factor. Author

N66-19583*# Bell and Howell Research Center, Pasadena, Calif.

A STUDY OF THE INTRODUCTION OF IONS INTO THE REGION OF STRONG FIELDS WITHIN A QUADRUPOLE MASS SPECTROMETER Quarterly Progress Report, 17 Aug.–17 Nov. 1965

Wilson M. Brubaker [1965] 79 p refs

(Contract NASw-1298)

(NASA-CR-70705) CFSTI: HC $3.00/MF $0.75 CSCL 20C

This project is a theoretical and experimental study of the introduction of ions into the strong fields of a quadrupole mass filter. Theoretical studies only have been made during the first quarter, although experimental apparatus have been assembled. These studies consist of computer-calculated trajectories of ions, including their passage through the fringing fields, where the field intensities grow from zero to full value. It is found that the maximum amplitudes of the ions as they traverse the filter are strongly dependent upon the assumed spatial distribution of the fringing fields. For the conventional quadrupole, operated at high resolving power, it is found that the transmission efficiency is extremely low, because only those ions which enter the quadrupole under nearly ideal conditions (on the axis and parallel to it) have trajectory amplitudes less than the distance to the rods. If, through the use of a second set of four electrodes, the dc component of the field is delayed relative to the ac component in the fringe region, the transmission efficiency is greatly increased. Author

N66-19609*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

EFFECTS OF SATURN VEHICLE LAUNCH NOISE ON WINDOW GLASS

Charles H. Sinex 15 Dec. 1965 38 p refs Supersedes TR-99-1, 16 Nov. 1964

(NASA-TM-X-57302; TR-99-1) CFSTI: HC $2.00/MF $0.50 CSCL 20A

Stucco-coated test structures containing commercial-size glass windows were exposed to sound pressure levels from 140 to 153 db during SA-4 through SA-9 launches. From the recorded test data, a mathematical analysis was performed which indicated that window failure was due to resonant vibration of the glass. This allowed prediction of the failure points of other windows. All tests and calculations showed that commercial and residential structures can withstand without damage sound pressure levels up to 130 db. Author

N66-19657*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.

DETERMINATION OF NEWTON'S GRAVITATIONAL CONSTANT, G, WITH IMPROVED PRECISION Status Report, 1 Apr.–30 Sep. 1965

J. W. Beams, A. R. Kuhlthau, R. A. Lowry, and H. M. Parker Dec. 1965 31 p refs

(Grant NGR-47-005-022)

(NASA-CR-70779; EP-4028-102-65U) CFSTI: HC $2.00/MF $0.50 CSCL 08N

Research is reported in applying new techniques to the laboratory determination of the Newtonian gravitation constant, with the expectation of improving the accuracy by about two orders of magnitude. The improvement is attributed to a new approach to the measurement and to better materials, metrology, and fabrication procedures. The apparatus is constructed such that two small masses are connected by a rigid horizontal rod. These are then placed in proximity to another pair of masses and the gravitational interaction between the two sets of masses results in a pure torque acting on the system. This torque is maintained constant by detecting changes in the relative angular position of the two mass systems, and correcting the relative position by a servo mechanism to maintain the position constant to the necessary accuracy. The nearly constant torque being applied to the system results in a nearly constant angular acceleration which can be permitted to act for an extended period of time. The ultimate measurement is one of determining the angular speed of the system at the end of this extended time period. C.T.C.

N66-19664*# J. G. Engineering Research Associates, Baltimore, Md.

METHODS FOR CALCULATING NOISE TRANSMITTED TO THE INSIDE OF SPACE VEHICLES FROM RANDOM LOADING ON THE OUTSIDE. PRELIMINARY IDEAS AND BASIC EQUATIONS Technical Report No. 4

Joshua E. Greenspon Mar. 1965 19 p refs

(Contract NAS5-9124)

(NASA-CR-70722) CFSTI: HC $1.00/MF $0.50 CSCL 20A

This report discusses the basic equations that can be used in computing the noise transmitted to the inside of a shell or shroud from random loading on the outside. The cylindrical shell is treated in some detail and the general relations for an arbitrary structure are presented. Author

N66-19700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REFLECTION OF SPHERICAL ELASTIC WAVE FROM THE BOUNDARY OF SEMISPACE

Kh. M. Aliyev 9 Nov. 1965 12 p refs Transl. into ENGLISH Zh. Prik. Mekhan. i Techn. Fiz (Moscow), no. 6, 1961 p 88–92

(FTD-TT-65-994/1+2+4; AD-624924) CFSTI: HC $1.00/MF $0.50

The reflection of a spherical elastic wave, propagating within an elastic semispace from its free flat boundary is investigated. It is assumed that the wave originates at the time moment t=0 as a result of normal stress applied to the surface of the spherical cavity of radius R_0, the center of which c_1 is situated at a distance l from the boundary. A geometric diagram of the problem is depicted; expressions for the tensor components are given; and calculations for solving the propagation problem are presented. L.S.

N66-19765*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

RIGID MOTIONS IN EINSTEIN SPACES

Hugo D. Wahlquist and Frank B. Estabrook 15 Mar. 1966 42 p refs

(Contract NAS7-100)

(NASA-CR-71283; JPL-TR-32-868) CFSTI: HC $2.00/MF $0.50 CSCL 20J

The dyadic formulation of general relativity is used systematically to discuss rigid congruences in Einstein space–time. For space–time of uniform curvature, the quotient space metrics of rotating and accelerating rigid bodies are obtained. For Einstein space–time of nonuniform curvature, all irrotational, nonisometric, rigid motions are explicitly displayed. They have one degree of freedom, and occur only in degenerate static metrics of Class B. Rotating rigid congruences in Einstein space–time of nonuniform curvature are shown to have no degrees of freedom. Their evolution is, in fact, found to be governed by a complete set of 14 first-order total differential equations, linear in the time derivatives of the dyadic variables. Such rotating motions are

shown further to be constrained by a set of algebraic conditions; the implication of this for the validity of the Herglotz–Noether theorem in Einstein space–time is discussed.
Author

N66-19773# California Univ., Los Angeles. Dept. of Engineering.
A BRIEF COMMENT ON THE HYDRAULIC ANALOGY OF AN ACOUSTIC WAVE IN A PIPE
Louis Solomon and Dorothy Elizabeth Cuadra Nov. 1965 25 p refs
(Contract Nonr-233(62))
(Rept.-65-45; AD-625088) CFSTI: HC $1.00/MF $0.50

The analogy between small amplitude wave propagation in shallow water and acoustic wave propagation in a uniform medium is discussed. A simplified first order theory is derived, based upon space-time techniques, in order to predict the magnitudes of the transmitted and reflected waves arising due to the incident wave encountering a small area change. Theoretical calculations agree favorably with experimental results. Photographs obtained from motion pictures of the unsteady phenomena are also presented. Author (TAB)

N66-19784# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF GENERATING OSCILLATIONS WITH A FREQUENCY WHICH IS DETERMINED BY THE LARMOR PRECESSION FREQUENCY OF NUCLEAR SPINS
R. M. Umarkhodzhayev 9 Dec. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 168334 (Appl. no. 826987/26-25, 22 Mar. 1963) 1 p
(FTD-TT-65-1170/1+4; AD-625071) CFSTI: HC $1.00/MF $0.50

A method is given of generating oscillations with a frequency determined by the frequency of the Larmor precession of nuclear spins which has the distinguishing feature that for the purpose of shorting the feedback one uses a central lateral (collateral) of nuclear magnetic resonance which is formed in the low-frequency modulation of a magnetic field. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-18512# Naval Radiological Defense Lab., San Francisco, Calif.
TOTAL NEUTRON CROSS SECTIONS OF COPPER, IRON, AND ALUMINUM NEAR 14 MeV
Jesse C. Albergotti and James M. Ferguson (San Francisco Univ.) 8 Nov. 1965 13 p refs
(USNRDL-TR-929; AD-625747) CFSTI: HC $1.00/MF $0.50

Total neutron cross sections of Mg, Al, Fe, and Cu have been measured using T (d, n) neutrons in the energy range 12 to 14 MeV. The accuracy (counting statistics) is better than 1%. The energy resolution (two standard deviations of the energy resolution function) varies from 35 to 150 keV. Fluctuations of amplitude 2 to 3% and width of the order of 100 keV are found in the cross sections of Mg and Al. No such variations are found in the cross sections of Fe and Cu; a chi squared test agrees with a straight line fit to the Fe and Cu data. Author (TAB)

N66-18572# Catholic Univ. of America, Washington, D. C. Div. of Nuclear Science and Engineering.
VARIABLE INTENSITY ISOTOPIC SOURCES Annual Summary Report, 1 Dec. 1964–30Jun. 1965
Edward D. Jordan and Thomas E. Carew Aug. 1965 25 p refs
(Contract Nonr-2249(13))
(AD-625415) CFSTI: HC $1.00/MF $0.50

The feasibility is studied of isotopic radiation sources of variable output. It is possible to change the effective yields of isotopic sources which have an output dependent on the interaction of alpha or beta particles with target materials. This can be accomplished by a change in source geometry in a manner which would result in an intimate associaton or separation of the radiation source material and the target matrix. The capability of changing the source output could facilitate the safe handling of a source of relatively high maximum output without requiring extensive shielding. Since these sources will produce some penetrating radiation in their lowest and the highest achievable output under conditions of variable source geometry must be considered. In a detailed investigation of possible (alpha,n) reactions, beryllium was determined to be the best target material while polonium 210 and plutonium 238 were the best alpha source materials. Engineering consideration applicable to heterogeneous neutron source designs are described. These include encapsulation for physical containment of polonium within the source, heat generation and heat transfer, and mechanisms of damage to stainless steel or gold windows used for containment of polonium. For variable output bremsstrahlung sources, four nuclides identified as most suitable are calcium 45, preomethium 147, strontium 90, and thulium 170. TAB

N66-18579# RAND Corp., Santa Monica, Calif.
NEUTRON CAPTURE IN THE ATMOSPHERE FROM HIGH ALTITUDE POINT SOURCES
J. I. Marcum Oct. 1965 29 p refs
(Contract AF 49(638)-66-C-0001; Proj. RAND)
(RM-4385-PR; AD-626147) CFSTI: HC $2.00/MF $0.50

Results are given for the spatial and time-dependence of neutron capture from a representative fission weapon spectrum and a 14 Mev monoenergetic source at altitudes of 10 km to 48.3 km in the real atmosphere. The solutions were obtained by the use of the RAND Monte Carlo Neutron Transport Code. A reasonable approximation to the energy disposition may be simply obtained by assuming that all the energy is locally deposited. If more precise results are desired, the gamma ray component of the thermal capture process should be treated as a further radiation transport problem.
Author (TAB)

N66-18691# Sandia Corp., Albuquerque, N. Mex.
DENDRITIC EROSION IN DIELECTRICS
Richard N. Work (Ariz. State Univ.) Oct. 1965 8 p refs Presented at the Conf. on Elec. Insulation, Buck Hill Falls, Pa.
(Contract AT(29-1)-789)
(SC-DC-65-1789; CONF-651028-1) CFSTI: HC $1.00/MF $0.50

A possible mechanism for dendritic erosion in dielectrics is considered, and its relation to the characteristics of growth is discussed qualitatively. The model described draws heavily from the theory of breakdown in gases, and uses the many points of similarity between the growth of discharges in solids and in gases. Author (NSA)

N66-18694# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

ELASTIC π^+–p SCATTERING AT 180° AND HIGH ENERGIES [UPRUGOE RASSEYANIE $^+$–MEZONOV NA PROTONAKH NA UGOL 180° PRI VYSOKIKH ENERGIYAKH]

A. S. Yovenko, B. N. Gus'kov, M. F. Likhachev, A. L. Lyubimov, Yu. A. Matulenko et al 1965 9 p refs In RUSSIAN (JINR-P-2327)

The differential elastic, π^+–p scattering cross section at a solid angle of 180° and at momenta of 4.10 and 4.85 BeV/c in the laboratory system was measured. The results were compared with those obtained previously (Phys. Lett. 17: 68 (1965)) using the same experimental method. In the calculation of the effective cross section values, corrections were made for the nuclear interaction of the primary and backscattered π^+ mesons and recoil protons in the H-containing target and the counter, the μ mesons in the beam, the decay of the scattered π mesons, and the efficiency of the scintillation counter, the electronic system and the spark chamber used. The results indicated a narrow peak close to 180°, at 4.0 BeV and a π^+–p back scattering peak at 4.85 BeV/c. The existence of a peak in the elastic π^+ back scattering in the high-energy range beyond 3 BeV is not due to resonance but is a characteristic of high-energy elastic scattering. (NSA)

N66-18695# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

MASS FORMULA IN SU(12) CONTAINS Sp(6) × Su(2) SYMMETRY [MASSOVYE FORMULY V SU(12) ⊃ Sp(6) × Su(2)-SIMMETRII]

A. V. Nikolov, I. T. Todorov, and D. G. Fakirov 1965 18 p refs In RUSSIAN (JINR-P-2342)

A study is presented at the SU(12)-symmetry in which the basic multiplets ("trions") consist of particles with half-integer spin and with integer electric and baryon charges. Mass formulas were obtained for mesons and baryons entering correspondingly into representations *143* and *364* under the assumption that the mass operator in the broken SU(12)-symmetry conserves not only spin, isotopic spin, and strangeness, but also the supercharge. In particular, for usual particles (with a hypercharge equal to zero) the well-known mass formulas obtained in the SU(6)-symmetry scheme are reproduced. Author (NSA)

N66-18699# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

A NEW APPROACH TO CONTINUUM POLARON THEORY

R. Evrard, E. Kartheuser, and J. DeVreese Jan. 1965 6 p refs Presented at the 2d Conf. on Solid State Phys., Bristol Univ., England, 5–8 Jan. 1965 *Its* Conf. Paper No. 114 (BLG-328; CONF-65117-1)

The polaron problem is treated in the Heisenberg representation. After the elimination of the phonon variables from the equations an harmonic approximation is made on the motion of the electron. For the first time nondivergent results for the energy of the polaron in the classical case are obtained. Author (NSA)

N66-18701# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.

GAMMA RAYS FROM ^{75}As(n,γ) ^{76}As REACTION

M. I. Crustu and M. S. Popa [1965] 17 p refs (IFA-NR-22)

By means of a gamma-gamma coincidence spectrometer using two NaI(Tl) crystals single and coincidence spectra from the ^{75}As(n,γ)^{76}As reaction were measured. More prominent gamma ray peaks appeared at 49.5, 89, 120, 136 and 163 keV in the single spectrum. The coincidence and sum-coincidence measurements revealed the following more intensive cascades: 120–163, 136–163, 163–220–275, 275–540 and 275–660 keV. The data obtained were used for derivation of the probable ^{76}As level scheme with level energies at 163, 283, 390, 480, 590, 660, 940, 1270, 1910, 2150, 2350, and 2550 keV. A discussion about the spins and parities of the lowest levels of ^{76}As nucleus is given. Author (NSA)

N66-18711# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ANGULAR DISTRIBUTION OF INELASTICALLY SCATTERED COMPLEX PARTICLES [UGLOVOE RASPREDELENIE NEUPRUGO RASSEY ANNYKH SLOZHNYKH CHASTITS]

B. N. Kalinkin and Ya. Grabovskii 1965 6 p refs In RUSSIAN (JINR-P-2331)

The angular distribution in inelastic scattering of complex nuclei accompanied by an excitation of low-lying levels of the collective type is discussed. Author (NSA)

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N66-18714# International Centre for Theoretical Physics, Trieste (Italy).

REMARK ON CROSSING SYMMETRY AND PARASTATISTICS

A. O. Barut, G. Ghika, and N. Limic May 1965 6 p refs (IC/65/51)

It is shown that under the following two assumptions identical particles cannot obey parastatistics: (1) every physical amplitude must belong to an irreducible representation of the permutation group of identical particles, and (2) the amplitudes satisfy the crossing property. NSA

N66-18715# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.

TRANSVERSE MOMENTUM DISTRIBUTION IN HIGH-ENERGY MESON PRODUCTION

E. M. Friedländer Jul. 1965 37 p refs (IFA-CR-55)

A survey of experimental data on the transverse momentum distributions of 5738 secondaries from high-energy inelastic interactions is analyzed. It is shown that the data cannot be fitted satisfactorily by the linear exponential distribution. The baryon data are well described by a Boltzmann distribution while the pion data are a superposition of two Boltzmann distributions with widely differing parameters. Author (NSA)

N66-18721# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

SOME REMARKS ON RADIATIVE KAON DECAYS [NEKOTORYE ZAMECHANIYA O RADIATSIONNYKH RASPADAKH K-MEZONOV]

E. I. Mal'tsev and I. V. Chuvilo 1965 14 p refs In RUSSIAN (JINR-P-2374)

Experimental data on radiative kaon decays are treated. A model with an intermediate boson pole involving a S^0 meson is discussed. Author (NSA)

N66-18733# International Centre for Theoretical Physics, Trieste (Italy).

MASS FORMULAE IN U(6)×U(6) THEORY

R. Delbourgo and R. White 28 Oct. 1965 7 p refs Submitted for Publication (IC/65/77)

An analysis similar to that used by Okubo and Marshak was used to obtain elementary particle mass relations from U(6)×U(6) theory. NSA

N66-18742# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF NEUTRON PROPAGATION IN CAVITIES [CONTRIBUTION A L'ETUDE DE LA PROPAGATION DES NEUTRONS DANS DES CAVITES]
Gilbert Hasselin Mar. 1965 132 p refs In FRENCH
(CEA-R-2774)

In large size cavities where the dimensions of the holes are greater than the mean free path of the radiations, neutron propagation calculations are carried out by taking into account the effect of the medium surrounding the hole using a reflection coefficient or albedo. The fast neutron albedos are obtained for various materials, and these results are applied for a Monte-Carlo propagation calculation. A comparison of this calculation with experimental results shows the validity of the method. Author (NSA)

N66-18759# European Atomic Energy Community, Brussels (Belgium).
IDENTIFICATION CHART FOR GAMMA EMITTING RADIONUCLIDES FORMED BY (n,γ) REACTIONS
F. Girardi, G. Guzzi, and J. Pauly 1965 14 p refs
(EUR-2408.e)

A chart for the identification of unknown gamma emitting radionuclides was prepared. It gives the energy and the intensity of the main gamma peaks of those radioisotopes formed by (n,γ) reaction which are of interest in activation analysis. The nuclides considered were represented in the order of half-life and in the alphabetic order of elements. The energy scale was chosen in such a way as to show the superimposition of gamma rays of slightly different energy in the same way as it appears on the oscilloscope of the multichannel analyzers. An effort was made to reduce the size of the chart to make it easy to handle and to read. Author (NSA)

N66-18761# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
AN INVESTIGATION OF INFRARED SINGULARITIES IN THE CROSS SECTIONS BY THE FUNCTIONAL INTEGRATION METHOD [ISSLEDOVANIE INFRAKRASNYKH OSOBENNOSTEI SECHENIYA RASSEYANIYA METODOM FUNKTSIONAL'NOGO INTEGRIROVANIYA]
B. M. Barbashov and M. K. Volkov 1965 14 p refs In RUSSIAN
(JINR-P-2309)

Using the functional integration method the high energy scattering of scalar particles with mass m is studied. This process is treated on the basis of the model of scalar particles with the Lagrangian $L=g:\psi^2(x)\ \phi\ (x)$ where the field $\psi(x)$ possesses a mass $\phi(x)$ and $\phi(x)$–the zero mass. The contribution of the virtual quanta of the field $\phi(x)$ with $k^2=0$ leading to the infrared singularity in the elastic process amplitude is taken into account exactly. Beyond the framework of perturbation theory the compensatiion procedure of the infrared divergences is made by taking into account the processes involving the emission of an infinite number of real quanta of a field $\phi(x)$ with a total energy not exceeding a certain quantity Δ. Author (NSA)

N66-18762# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ANALYSIS OF $\pi^-+p\to\pi^-+\pi^+$+n AND $\pi^-+p\to\pi^-+\pi^0$+p REACTIONS AT THE π^- KINETIC ENERGY OF 338 MeV [ANALIZ REAKTSII $\pi^-+p\to\pi^-+\pi^+$+n i $\pi^-+p\to\pi^-+\pi^0$+p PRI KINETICHESKOI ENERGII π^- MEZONOV 338 MeV]
T. D. Blokhintseva, V. G. Grebinnik, V. A. Zhukov, G. Libman, L. L. Nemenov et al 1965 12 p refs In RUSSIAN
(JINR-P-2320)

The differences in the cross sections of the isobar channels for the $\pi^-+p\to\pi^-\pi^+$+n(I) and $\pi^-+p\to\pi^-\pi^0$+p(II) reactions are determined at the π^- meson kinetic energy of 338 Mev. If the isobar transitions occur in T=1/2 state the total cross section for (II) within the experimental error is equal to the sum of the cross sections of the isobar channels. Under this assumption the total cross section for (I) is not described by the sum of the cross sections of the corresponding isobaric channels. The effect of $\pi\pi$ interaction manifests itself in the $\pi^+\pi^-$ effective mass spectrum but not in the $\pi^-\pi^0$ mass spectrum. The presence of the (3/2,3/2) isobar affects the angular distributions of secondary particles from (I). Author (NSA)

N66-18763# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESON CURRENT IN BROKEN SYMMETRY U(12) AND EXPERIMENTS WITH COLLIDING BEAMS [MEZONNYI TOK V NARUSHENNOI SIMMETRII U(12) I OPYTY NA VSTRECHNYKH PUCHKAKH]
P. Winternitz, A. A. Makarov, Nguyen Van Hieu, L. G. Tkachev, and M. Uglirzh 1965 7 p refs In RUSSIAN
(JINR-P-2300)

The general structure of the matrix element of the meson current is studied in the broken $\overline{U}(12)$ symmetry. Further this current is used to calculate the cross sections for the production of meson pairs in colliding electron-positron beams. Author (NSA)

N66-18764# Columbia Univ., New York. Dept. of Physics.
LARGE-SPIN ROTATIONAL STATES OF DEFORMED NUCLEI
Samuel M. Harris [1964] 9 p refs
(Contracts AT(30-1)-1934; AT(30-1)-1420)
(COO-1420-104)

A simple explanation for the dependence of moment of inertia (I) on the degree of rotation is proposed, using comparison of calculated and measured values for W-174, W-176, Hf-166, Hf-168, Hf-170, Hf-172, Yb-164, and Yb-166 as a basis. NSA

N66-18772# Bettis Atomic Power Lab., West Mifflin, Pa.
THE UTILIZATION OF THE NEUTRON DIFFUSION PROGRAM PDQ-5
L. A. Hageman and C. J. Pfeifer Jan. 1965 72 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-395) CFSTI: HC $3.00/MF $0.75

The PDQ-5 program provides a discrete numerical approximation to the two-dimensional, time-independent neutron diffusion problem. A general description is given of the computational methods employed by the program, and the significance of the output numbers is defined and discussed. Some numerical examples are given. Author (NSA)

N66-18777# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SYMMETRY GROUP SL(6) AND RELATIVISTIC GENERALIZATION OF SU(6), PART II [GRUPPA SIMMETRII SL(6), RELYATIVISTSKOE OBOBSHCHENIE GRUPPY SIMMETRII SU(6), II]
Nguyen Van-Hieu 1965 14 p refs In RUSSIAN
(VINR-P-1991)

The wave equations are treated for the third and second rank spinors of the SL(6) group. A method of studying the broken SL(6) symmetry is discussed. Author (NSA)

N66-18780# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE SYMMETRY GROUP SL(6) AND A RELATIVISTIC GENERALIZATION OF THE SU_6 SYMMETRY [GRUPPA SIMMETRII SL(6) I RELYGTIVISTSKOE OBOBSHCHENIE GRUPPY SIMMETRII SU_6]
Nguyen van Hieu 1965 14 p refs In RUSSIAN
(JINR-P-1954)

The symmetry of elementary particles which is based on the SL(6) group and is a relativistic generalization of SU_6 symmetry is treated. A generalized Dirac equation for the spinors of the SL(6) group is studied. The interaction lagrangian for the meson multiplet with the vector and axial currents was obtained. It is shown that this meson multiplet contains either a nonet of vector mesons and a nonet of pseudovector mesons, or a nonet of vector mesons and an octet of pseudoscalar mesons. In the latter case the interaction between axial currents and pseudoscalar mesons is an interaction involving a derivative. Author (NSA)

N66-18781# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SCATTERING OF LIGHT OF LOW FREQUENCY AND THE CHARGED PARTICLE POLARIZABILITY [RASSEYANIE SVETA NIZKOI CHASTOTY I POLYARIZUEMOST ZARYAZHENNOI CHASTITSY]
S. B. Gerasimov and L. D. Solovev 1965 6 p refs In RUSSIAN
(JINR-P-1941)

The cross section for the quasi-elastic scattering of photons of a low-energy ω by a charged particle is considered, up to terms quadratic in ω and taking into account the radiative corrections. Among the quadratic terms the main ones, namely of the order $\omega^2 \ln \omega$, are found. Up to these terms the quasi-elastic scattering is determined, apart from the charge and mass of the particle, by the dynamic polarizability of the scatterer, which is proportional to $\ln \omega$. Author (NSA)

N66-18782# Los Alamos Scientific Lab., N. Mex.
SYMMETRY OF THE STRESS TENSOR
James A. Mc Lennan [1964] 9 p refs
(Contract W-7405-ENG-36)
(LA-DC-6556) CFSTI: HC $1.00/MF $0.50

The stress tensor for a medium with internal angular momentum is considered, and it is shown how a symmetric stress tensor can be formed. Construction of the symmetric tensor requires that the contribution to the linear momentum of a distribution of internal angular momentum be taken into account. Author (NSA)

N66-18796 Argonne National Lab., Ill.
NEUTRON EMISSION FROM U^{233}, U^{235} AND Pu^{239} FISSION FRAGMENTS
V. F. Apalin, Yu. N. Gritsyuk, I. E. Kutikov, V. I. Lebedev, and L. A. Mikaelyan Jun. 1965 13 p refs Transl. into ENGLISH of "Emissiya Neitronov Iz Oskolkov Deleniya U^{233}, U^{235}, Pu^{239}", Gos. Kom. Po Ispol'z. At. Energii SSSR, Moscow, Preprint IAE-710, 1964 p 1-16
(ANL-TRANS-205) CFSTI: HC $1.00/MF $0.50

Quantitative data were obtained for the neutron emission in the symmetric fission region. The number of ghost events recorded in this region could be decreased to 15+20%. Author (NSA)

N66-18798# Harvard Univ., Cambridge, Mass. Dept. of Physics.
PHOTOPRODUCTION OF CHARGED PION PAIRS
Louis John Lanzerotti (Ph.D. Thesis) May 1965 183 p refs
(Contract AT(30-1)-2752)
(HUX-2752-7) CFSTI: HC $5.00/MF $1.00

An experiment is described in which the photoproduction of charged pion pairs in carbon and hydrogen in the BeV energy range was observed near the forward direction. Particles were detected by two mirror-image spectrometer telescopes consisting of plastic scintillation counters and half-quadrupole magnets. Angle and momentum defining hodoscope counter arrays were connected on-line to a PDP-1 computer and provided three percent mass resolution. The invariant mass of the dipion system ranged from 0.300 to 1.50 BeV. The non-resonant pion pair cross section was found to decrease sharply with increased photon energy and to be produced by a predominately incoherent process. Enhancement of the dipion cross section at a mass of 0.740 $\pm$0.005 BeV was caused by copious ρ^0 meson production. The observed ρ^0 width was 0.150 BeV. Production of the ρ^0 was observed at energies of 4.4 and 2.52 BeV and angles of 0°, 3.5°, and 6°. The ρ^0 production at 0° and 3.5° at an energy of 4.4 BeV was also measured for aluminum and copper. The energy and angular dependence of the ρ^0 production gave evidence for production by a diffraction mechanism. Production of the ρ^0 on the higher A targets showed evidence for coherent production near 0°. Complete polarization of the resonance was observed for a 2.52 Bev ρ^0 produced at 0° in carbon. Evidence was seen for a possible additional enhancement of the dipion cross section at a mass of 0.500 Bev. This was observed to be a very wide enhancement produced by an incoherent mechanism. Author (NSA)

N66-18804# Los Alamos Scientific Lab., N. Mex.
THE APPROXIMATE DOPPLER BROADENING OF AN ISOLATED NUCLEAR RESONANCE
Joseph J. Devaney Mar. 1965 39 p refs
(Contract W-7405-ENG-36)
(LA-3315) CFSTI: HC $2.00/MF $0.50

The narrow, isolated nuclear resonance cross sections of an isotope are broadened by thermal motion of the target nuclei. A few approximate formulas are given for calculating such broadening. NSA

N66-18805# Oak Ridge National Lab., Tenn.
SPECTRA OF GAMMA RAYS PRODUCED BY THE INTERACTION OF ~160-MeV PROTONS WITH Be, C, O, Al, Co, AND Bi
W. Zobel, F. C. Maienschein, and R. J. Scroggs Apr. 1965 75 p refs
(Contract W-7405-ENG-26)
(ORNL-3506) CFSTI: HC $3.00/MF $0.75

A measurement of the gamma rays in the energy range from 0.6 to 11 Mev resulting from bombardment of Be, C, H_2O, Al, Co, and Bi targets with ~160-Mev protons has been completed. A three-crystal scintillation spectrumeter was used as a pair spectrometer for photons having energies above 2 Mev and as a total-absorption, anticoincidence spectrometer for photons having energies below 2.5 Mev. A time-of-flight method was used to reject neutrons, with an average rejection efficiency of 0.70±0.01. Data were obtained in the form of pulse-height spectra, which were converted to photon spectra by a computer-programmed "unscrambling" technique, resulting in the assignment of upper and lower spectral bounds representing a 68% confidence interval. The bulk of the data was obtained at 136° from the direction of the proton beam; other data obtained with aluminum targets at 44° and 20.5° gave no evidence of anisotropy. Discrete gamma rays were found for all materials except bismuth. Cross sections for the production of these gamma rays were computed

and plausible assignments were made for the transitions giving rise to these lines. In the case of Al, Co, and Bi a continuum was observed, underlying the discrete spectrum for the aluminum and cobalt targets. The total gamma-ray production cross sections for photons in the energy range from 0.6 to 11 Mev were calculated to be: Be, (6.8±1.3) mb; C, (41.4±6.3) mb; O, (115±22) mb; Al, (434±97) mb; and Co, (1050±220) mb. Author (NSA)

N66-18812# California Univ., Berkeley. Lawrence Radiation Lab.

THE PROMPT GAMMA RAY, PROMPT ELECTRON AND PROMPT X-RAY SPECTRA ASSOCIATED WITH FISSION FRAGMENTS OF SPECIFIC MASS

Harry R. Bowman, Stanley G. Thompson, Rand L. Watson, S. S. Kapoor, and John O. Rasmussen 27 Jan. 1965 27 p refs Presented at Symp. on the Phys. and Chem. of Fission, Salzburg, Austria.

(Contract W-7405-ENG-48)

(CONF-650301-5; UCRL-11902) CFSTI: HC $2.00/MF $0.50

Well-defined prompt gamma rays, prompt-conversion electrons, and prompt K X-rays have been observed in coincidence with moving fission fragments of ^{252}Cf. In a few cases, the masses and charges of the nuclei emitting the gamma rays and conversion electrons have been identified. The gamma-ray, prompt-electron and prompt X-ray energies, as well as the two fission fragments' energies, were measured with high-resolution solid-state detectors. The masses of the fragments were deduced from their energies, and the nuclear charges were determined by measuring K X-ray energies associated with different masses. The magnitude and sign of the Doppler shift in gamma energy allowed assignment of the gamma lines to single members of fragment pairs. The Doppler shift also provides an independent measure of the fragment velocity and hence the fragment mass after neutron emission. The results of the X-ray measurements are consistent with the view that the majority of the prompt X-rays emitted during the spontaneous fission of ^{252}Cf results from internal conversion during the de-excitation of low-energy collective states of the primary fission fragments. Author (NSA)

N66-18820# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

SOME REMARKS ON THE ASSIGNMENTS OF THE FURNACE ABSORPTION SPECTRA OF Ce, Nd, AND Sm

Sima Held Jan. 1965 42 p refs Sponsored in part by Natl. Bur. of Std.

(IA-964)

The furnace absorption spectra of Ce, Nd^{14}, and Sm were investigated in order to determine whether all the lines belong to the neutral atom spectrum. The spectrum assignments were made using only a d-c arc as the excitation source. It was observed that in the ultraviolet and red spectral ranges not all the absorption lines previously reported belong to the neutral atom spectrum. The spectrum assignments of the stronger Nd lines in the long wavelength region are given. The method of sorting the atom and ion spectra of rare earth elements used may be helpful in the long wavelength region. Author (NSA)

N66-18822# Aktiebolaget Atomenergi, Stockholm (Sweden).

HINDERED E1 TRANSITIONS IN Eu^{155} AND Tb^{161}

Sven G. Malmskog Feb. 1965 22 p refs

(AE-179)

The absolute E1 transition probabilities from the 3/2+ (411), 5/2−(532), and 7/2−(523) single particle levels in ^{155}Eu and ^{161}Tb were measured by the method of delayed coincidences. Half lives of $T_{1/2}<0.2$ nsec and $T_{1/2}=(1.38 \pm 0.06)$ nsec for the 104.4 and 246 kev levels in ^{155}Eu and $T_{1/2}=(0.84 \pm 0.04)$ nsec and $T_{1/2}<0.2$ nsec for the 417.6 and 480.6 kev levels in ^{161}Tb were found. The result is compared with the calculations of a single particle in a deformed potential carried out by Nilsson. Author (NSA)

N66-18831# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentazione.

RECENT CALCULATIONS ON ELECTRON-POSITRON COLLIDING BEAM EXPERIMENTS

R. Gatto 27 Feb. 1965 14 p refs Submitted for Publication /ts Nota Interna No. 274

(LNF-65/8)

A summary of recent work carried out in Frascati and in Florence, and of previous work related to experiments of colliding e^+-e^- beams, is presented. Radiative corrections are given for colliding electron and positron beams. Radiative corrections are also given for antiproton-proton collisions. The total cross section for $e^+ + e^- \rightarrow \pi^+ + \pi^- + \pi^0$ as a function of the beam energy is included. NSA

N66-18833# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INTERACTIONS OF FAST PROTONS WITH HEAVY NUCLEI [VZAIMODEIBTIVE BYSTRYKH PROTONOV S TYAZHELYMI YADRAMI]

V. S. Barashenkov, V. M. Mal'tsev, and V. D. Toneev 1965 14 p refs In RUSSIAN

(JINR-P-1969)

Within the framework of the cascade-evaporation model different characteristics of proton interactions with ^{238}U nuclei in the range 100–700 Mev are calculated. The nuclear fission process is taken into account. It is shown that the model is in good agreement with experimental data. A discrepancy is observed only for the yield of some fission products. Possible reasons for this discrepancy are discussed. Author (NSA)

N66-18834 Los Alamos Scientific Lab., N. Mex.

AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. VIII: THERMAL ELLIPSOID ORIENTATION

Allen C. Larson, R. B. Roof, Jr., and Don T. Cromer 6 Aug. 1965 29 p refs

(Contract W-7405-ENG-36)

(LA-3310) CFSTI: HC $2.00/MF $0.50

The procedures employed and the computer program used for determining the principal axes and the orientation of anisotropic thermal ellipsoids relative to crystallographic axes are described. This information is often useful in correlating the thermal vibrations of the atoms of a single crystal with its various other physical properties. Author (NSA)

N66-18835# Los Alamos Scientific Lab., N. Mex.

AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. VII: INTERATOMIC DISTANCE AND ANGLE CALCULATIONS

Allen C. Larson, R. B. Roof, Jr., and Don. T. Cromer 28 Jul. 1965 41 p ref

(Contract W-7405-ENG-36)

(LA-3309) CFSTI: HC $2.00/MF $0.50

The procedures employed and the computer program used for determining the distances between atoms in a unit cell are described. Any three atoms may be characterized by two vectors, each with an end common to one of the three atoms. The program may also be used to determine the angle between these two vectors. Author (NSA)

N66-18840# Sandia Corp., Albuquerque, N. Mex.
TRANSMISSION OF X-RAYS THROUGH AIR
James H. Renken Apr. 1965 41 p refs
(Contract AT(29-1)-789)
(SC-RR-65-141) CFSTI: HC $3.00/MF $0.50

The transport equation describing the transmission of photons through a medium which both scatters and absorbs radiation is considered. After specializing to the case of a point source emitting isotropically into a homogeneous medium, a solution for the photon density as a function of various parameters is obtained by using the polynomial method of Fano and Spencer. Sample numerical results are given. Author (NSA)

N66-18841# Los Alamos Scientific Lab., N. Mex.
MOMENTS EQUATIONS AND EQUIVALENT DISCRETE ORDINATES EQUATIONS. PART I: GENERALIZED MOMENTS EQUATIONS. PART II: EQUIVALENT DISCRETE ORDINATES EQUATIONS
B. G. Carlson and K. D. Lathrop [1965] 10 p refs Presented at the 13th Conf. on Remote Systems Technol., Washington
(Contract W-7405-ENG-36)
(CONF-6511-29; LA-DC-7320) CFSTI: HC $1.00/MF $0.50

There are two common means of approximating the analytic Boltzmann transport equation: by a finite set of coupled equations among angular moments of the distribution function, and by a discrete ordinates representation of the angular dependence. The derivation of moments equations is illustrated in which the assumed form of the angular representation may be freely chosen. Such moments equations have the advantage that the angular dependence assumed may be tailored to suit the requirements of a specific problem without altering the form of the moments equations themselves. Discrete ordinates equations are established that are equivalent to the moments equations that were firstly derived. The equivalent discrete ordinates system may usefully be solved instead of the moments system; in addition, the requirements of equivalence provide guidelines for the selection of quadrature coefficients in discrete ordinates systems. Author (NSA)

N66-18842# Maryland Univ., College Park. Inst. for Molecular Physics.
TRANSPORT PROPERTIES OF GASEOUS He^3 AND He^4
L. Monchick (APL), E. A. Mason, R. J. Munn, and Francis J. Smith 1 Mar. 1965 29 p refs
(Contract AT(40-1)-2058)
(IMP-AEC-34) CFSTI: HC $2.00/MF $0.50

A complete quantum phase shift calculation of several transport coefficients of gaseous ^3He, ^4He, and ^3He–^4He mixtures has been carried out from 0.2 to 300°K for a Lennard-Jones (12—6) potential model. Emphasis was placed on those properties for which experimental data were available, such as the voscosity of ^4He, the thermal conductivity of ^3He and ^4He, the spin diffusion of He, and ordinary diffusion and thermal diffusion of ^3He–^4He mixtures. Author (NSA)

N66-18843# Atomics International, Canoga Park, Calif.
SHOE—A SHIELD WEIGHT OPTIMIZATION CODE
R. L. Bernick 15 Jan. 1965 59 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-10922) CFSTI: HC $3.00/MF $1.00

The SHOE code, a FORTRAN computer code designed to calculate the optimum dimensions of a 3-region laminated radiation shield surrounding a spherical reactor core, is described. The method of optimization employed is a modification of the method of steepest descent. A listing of the code and the input and output for a sample problem are included. Author (NSA)

N66-18844# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SU(6)-SYMMETRY AND ITS POSSIBLE GENERALIZATIONS
V. G. Kadyshevskii, R. M. Muradyan, A. N. Tavkhelidze, and I. T. Todorov 1965 10 p refs
(JINR-D-1929)

A possible generalization of the Lie algebra of SU(6) group is considered, which takes into account higher angular momenta. A 108-parametrical group G is proposed in which the Poincare group and internal U(3) symmetry group are joined together, the SU(6) group being contained as a subgroup in it. Author (NSA)

N66-18847# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
WORK METHODS FOR THE POST-IRRADIATION EXAMINATION OF EXPERIMENTAL FUEL ELEMENTS
A. S. Bain, R. D. Mac Donald, D. B. Kerr, J. R. Kelm, and R. J. Chenier Mar. 1965 14 p refs *Its* Paper No. 51
(AECL-2226) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

At Chalk River, the personnel engaged on materials research operate two high-density concrete hot cells and a line of seven lead-shielded dry boxes for the examination of irradiated fuel specimens, both metal and ceramic. Transfer techniques and working methods for a typical examination are described. Experience over the past nine years has shown that having the research personnel directly in charge of the detailed postirradiation examination has several advantages, such as flexibility in scheduling, knowledge of the limits of remote control operation allowing rapid development of suitable equipment, and elimination of misunderstandings and delays in the dissemination of postirradiation results. Author (NSA)

N66-18849# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
VARIATIONAL SYNTHESIS WITH DISCONTINUOUS TRIAL FUNCTIONS
E. L. Wachspress and M. Becker Feb. 1965 22 p refs Presented at Intern. Conf. on Appl. of Computer Methods to Reactor Probl., Argonne, Ill., May 1965 Submitted for Publication
(Contract W-31-109-ENG-52)
(Conf-650501-4) CFSTI: HC $1.00/MF $0.50

The multichannel flux synthesis method for treating neutron-diffusion problems in several dimensions is considered. In this method, regions are represented by nodes, and nodal difference equations are derived with the aid of the lower-dimensional results. By suitably choosing a functional and trial functions, nodal difference equations are derived from variational principles. Discontinuous trial functions are used. Methods for obviating the difficulties presented by these discontinuities are discussed. NSA

N66-18852# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
CP VIOLATION AND INTERFERENCE PHENOMENA IN DECAY OF NEUTRAL K MESONS INTO TWO PIONS
V. L. Lyuboshits, E. O. Okonov, M. I. Podgoretskii, and Tsun-Fan Wu 1965 18 p refs
(JINR-D-1926)

The interference effects in the $K^0 \to \pi^+\pi^-$ decays are considered in the case of CP–invariance violation. It is shown that these effects are very pronounced under certain conditions. Their study makes it possible to solve the problem concerning the existence of the $\bar{K}_2^0 \to \pi^+ + \pi^-$ decay. The "beating" in the $\pi^+\pi^-$ system has been considered for the K^0 and $\bar{K}^0$

meson beam as well as for the case of the interference of the $K_2^0 \rightarrow \pi^+ + \pi^-$ decay with that of K_1^0 mesons arising as a result of regeneration from the plate. Author (NSA)

N66-18855# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
TRIPLE FISSION OF U^{235} WITH RESONANCE NEUTRONS [TROINOE DELENIE U^{235} NA REZONANSNYKH NEITRONAKH]
I. Kuitek, Yu. P. Popov, and Yu. V. Ryabov 1965 9 p refs In RUSSIAN Presented at the Symp. on the Physics and Chem. of Fission, Salzburg, Austria, 22–28 May 1965
(JINR-P-2025; CONF-650301-15)

The ratio of ternary and binary fission of ^{235}U by monochromatic neutrons in the energy range 0.1 to 50 ev was measured. The ternary fission was identified by coincidences of fission fragments with an α particle which eliminated the possible influence of α particles from ^{235}U (in,α) reaction on the obtained results. NSA

N66-18862# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A-PARITY AND Sp 6 SYMMETRY [A-CHETNOST I Sp 6 SIMMETRIYA]
B. V. Struminskii 1965 4 p refs In RUSSIAN
(JINR-P-2058)

An interpretation of the A-parity of Bronzan and Low is given in the framework of the Sp(6) symmetry of strong interactions. Author (NSA)

N66-18869# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE AMPLITUDE OF INELASTIC SCATTERING OF FAST PARTICLES BY NUCLEI [OB AMPLITUDE NEUPRUGOGO RASSEYANIYA BYSTRYKH CHASTITS NA YADRAKH]
I. Zh. Petkov 1965 7 p refs In RUSSIAN
(JINR-P-2037)

The amplitude of inelastic scattering of particles by nuclei is considered in a high-energy approximation. The problem reduces to the solution of the homogeneous system of the first order differential equations. Approximate expressions for the elastic and inelastic scattering amplitude are given taking into account one or two excited states of a nucleus. The calculated cross section for inelastic scattering of electrons with 0^+ state excitation is compared with the corresponding cross section in the framework of the method of distorted waves. Author (NSA)

N66-18879# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.
PHOTOPRODUCTION OF π^+ ON PROTON AT 0° IN THE ENERGY RANGE 300 TO 600 MEV
J. C. Bizot, J. Perez y Jorba, and D. Treille Jun. 1965 11 p refs
(LAL-1139)

Cross sections for the 0° π^+ photoproduction on protons between 200 and 600 Mev were measured, using a bremsstrahlung beam from the electron linear accelerator and employing a scheme of triple focusing spectrometer, lead absorbers, and plastic scintillation counters in coincidence to eliminate positrons formed in the interaction. Results are presented and compared with previous measurements and calculations. NSA

N66-18882# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
PERSISTENT CURRENTS INDUCED BY CIRCULARLY POLARIZED WAVES IN A SUPERCONDUCTING RING [CORRENTI PERSISTENTI INDOTTE DA UN ONDA POLARIZZATA CIRCOLARMENTE IN UN ANELLO SUPERCONDUTTORE]
C. Guaraldo, G. Sacerdoti, and A. Susanna 7 May 1965 10 p refs In ITALIAN *Its* Internal Note No. 278
(LNF-65/15)

The possibility of inducing persistent currents in superconducting rings using circularly polarized electromagnetic waves was examined. The possible physical data that can be obtained from the measurement of the persistent currents thus induced are discussed. NSA

N66-18883# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
PR^{138} DECAY [RASPAD PR^{138}]
A. S. Basina, T. Bedike, K. Ya. Gromov, B. S. Dzhelepov, N. A. Lebedev et al 1965 16 p refs In RUSSIAN
(JINR-P-2032)

The gamma, γ-γ- and β^+-γ-coincidence, and conversion-electron spectra of ^{138}Pr were studied. The presence of the 300–1040–800 kev transition cascade in ^{138}Pr decay is proved. The multipolarity of the 300- and 789-kev transitions is determined. Quantum characteristics 4+ and 7– are established for the 1840- and 2140-kev levels in ^{138}Ce respectively. Author (NSA)

N66-18887# State Univ. of New York, Stony Brook. Dept. of Chemistry.
NUCLEAR REACTION STUDIES Progress Report, Year Ending 31 May 1965
John M. Alexander et al [1965] 23 p refs
(Contract AT(30-1)-3403)
(TID-21716) CFSTI: HC $1.00/MF $0.50

Results of studies concerning the reactions of ^{209}Bi with ^3He and ^4He are presented in which scattering of recoils in the target layer and angular resolution corrections due to finite collection area, finite target area, and beam angular definition were investigated. The experiments were conducted using various target thicknesses and collection geometries. Work toward a better understanding of the deexcitation of compound nuclei with high angular momenta is reported in which the standard spin-dependent statistical model of the decay process was programmed to yield cross sections for products of the type (X–xn) and spectra of the emitted particles and radiations. The program was applied to the reaction $^{140}Ce(^{16}O,xn)^{156-x}Dy$. Results using O ions at 90 Mev and x=3 to 6 agree with experimental findings. Investigations of ^{209}Bi reactions with ^{16}O were conducted to study the near-barrier production of ^{211}At and ^{210}Po, and to obtain absolute cross sections for production of α emitters at bombarding energies from threshold to 163 Mev. Another investigation was conducted to determine the respective roles of fission, fragmentation, and spallation in the production of ^{149}Tb by irradiation of ^{197}Au with 2.2-Bev protons. Data on angular distribution of ^{149}Tb products and range distribution are included. NSA

N66-18888# Los Alamos Scientific Lab., N. Mex.
COUPLING CONSIDERATIONS IN TWO-ELECTRON SPECTRA
Robert D. Cowan and Kenneth L. Andrew (Purdue Univ.) [1964] 64 p refs Prepared jointly with Purdue Univ.
(Contract W-7405-ENG-36)
(LA-DC-6548) CFSTI: HC $3.00/MF $0.75

The energy level structure, relative line strengths, and Lande g-factors of two-electron configurations are discussed for four important types of pure coupling LS, LK, jK(jl), and jj. Transitions from one type of coupling to another are discussed in detail, using the configuration pf as an example. The appropriateness of LS- and jj-coupling notation in two-electron spectra is quite limited for atoms of medium atomic weight, where nearly all excited configurations show a strong tendency toward pair (LK to jK) coupling. For other atoms, pair coupling occurs mainly for high values of orbital angular momentum of the excited electron; the coupling may be near LK for small values of the principal quantum number of this electron, and it approaches pure jK as this quantum number increases. It is emphasized that LK or jK notation would best be used only when the coupling conditions approximate LK or jK coupling, respectively; either notation can serve to unambiguously identify levels throughout the range of intermediate pair couplings, but will not correctly designate the nature of the quantum states because of reversals of the L and j compositions of certain states as the coupling conditions change from pure LK to pure jK. Author (NSA)

N66-18890# International Centre for Theoretical Physics, Trieste (Italy).
CAN THE COUPLING CONSTANT ASSUME ARBITRARY VALUE IN THE S-MATRIX THEORY
Tetsuo Sawada Jan. 1965 12 p refs
(IC/65/6)

A relation is found between masses and coupling constants, within the framework of S-matrix theory, starting from the assumption of maximal analyticity of the scattering amplitude. NSA

N66-18895# Phylatron Corp., Columbus, Ohio.
DEVELOPMENT OF A HIGH-SENSITIVITY FAST NEUTRON DOSIMETER Quarterly Report No. 7, 1 Nov. 1964–31 Jan. 1965
B. H. Chase, R. R. F. Speers, J. M. Swartz, and M. O. Thurston [1965] 5 p
(Contract AT(11-1)-1226)
(TID-21547) CFSTI: HC $1.00/MF $0.50

A model of the high-sensitivity readout system was constructed during the period and diode processing studies were continued. Construction of an exposure chamber for the Pu–Be source is in progress. NSA

N66-18896# Hahn-Meitner-Institut für Kernforschung, Berlin (West Germany).
DIFFUSION OF RARE GASES IN SOLIDS Quarterly Report No. 18, Oct.–Dec. 1964
Jan. 1965 23 p refs Transl. into ENGLISH from German
(Contract EURATOM-028-64-1 TEE(RD))
(EURAEC-1314; EU-837) CFSTI: HC $1.00/MF $0.50

A collection of magnitudes that is used for evaluating ideal volumetric diffusion is given. Studies on sintered UO_2 powder showed that the initial burst that occurs in PAD tests is possibly due to the release of recoil-induced atoms. With reference to an experiment on Xe diffusion from a UO_2 single crystal sphere, an initial example is given for the calculation of the diffusion fraction from the rare gas release when the fraction liberated by evaporation of a sample cannot be more than twice the diffusion fraction. In the case of ^{41}Ar and ^{39}Ar diffusion in KF it was found that: $D=7.7\times10^{7}$ exp $(-40400/RT)$ at 350–800°C. In the case of tritium diffusion in an Ag–Li alloy under neutron bombardment it was found that: $D=1.05\times10^{-2}$ exp $(-11500/RT)$ at 300–550°C. Author (NSA)

N66-18898# Aktiebolaget Atomenergi, Stockholm (Sweden).
IMPROVEMENTS IN APPLIED GAMMA-RAY SPECTROMETRY WITH GERMANIUM SEMICONDUCTOR DETECTOR
D. Brune, J. Dubois, and S. Hellstroem Jan. 1965 17 p refs
(AE-174)

A germanium semiconductor detector is used in four cases of applied gamma spectrometry. In one case the weak activity contribution of ^{134}Cs in ^{137}Cs standard sources has been determined. The second case concerns the determination of ^{42}K in samples of biological origin containing strong ^{24}Na activities. In the third case the ^{94}Nb and ^{95}Nb activities from neutron-irradiated niobium foils used in the dosimetry of high neutron fluxes with long exposure times have been completely resolved, and it has been possible to determine the ratio of the two activities with a high degree of accuracy. Finally, a ^{95}Zr–^{95}Nb source has been analyzed in a similar way with respect to its radiochemical composition. The resolution obtained also made possible a determination of the branching ratio of the two gamma transitions in ^{95}Zr and of the energies of the gamma transitions of both nuclides. Author (NSA)

N66-18912# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE LOCALIZABILITY OF A FIELD THEORY WITH RESPECT TO NONCOMMUTING COORDINATES [O LOKAL'NOSTI TEORII POLYA PO NEKOMMUTIRUY-USHCHIM KOORDINATAM]
M. I. Shirokov 1965 13 p refs In RUSSIAN
(JINR-P-1934)

A certain class of coordinate operators r_μ are considered. These operators are different from the usual operator x_μ but, in some sense, are close to it. The theory of the self-interacting scalar field of the ϕ^3 type is taken. It is shown that the requirement for the interaction to be local with respect to the eigenvalues of a coordinate operator is consistent with the unitarity condition and the translational-Lorentz invariance of the theory only in the case of the operator x_μ. Author (NSA)

N66-18913# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON LIMIT OF APPLICABILITY OF PERTURBATIONS FOR WEAK INTERACTIONS[O PREDELE PRIMENIMOSTI TEORII VOZMUSHCHENII DLYA SLABYKH VZAIMODEISTVII]
Qui-Tu Pham 1965 10 p refs In RUSSIAN
(JINR-P-2071)

Using the unitarity condition, upper estimates have been obtained for the boundary of the energy region where the perturbation theory is applicable for weak interactions. Author (NSA)

N66-18915# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON INELASTIC SCATTERING OF COMPLEX NUCLEI [O NEUPRUGOM RASSEYANII SLOZHNYKH YADER]
F. A. Gareev and V. N. Kalinkin 1965 11 p refs In RUSSIAN
(JINR-P-2030)

A semiclassical approximation is used to determine the role of various factors which influence the inelastic scattering cross section for complex nuclei. It is shown that a rather simple analysis of experimental data may be made when energies considerably exceed the Coulomb barrier and the charge of the heavy ion is large. Author (NSA)

N66-18916# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ON LEVEL SCHEME FOR Sm^{145} FROM Eu^{145} DECAY [O SKHEME UROVNEI Sm^{145} IZ RASPADA Eu^{145}]
I. Demeter, F. Mol'nar, E. Nadzhakov, and A. F. Novgorodov 1965 17 p refs In RUSSIAN
(JINR-P-2052)

The γ spectrum, γ-γ coincidences, and γ-γ angular correlations of the ^{145}Eu–^{145}Sm decay were investigated using a scintillation coincidence spectrometer. The ^{145}Eu isotope was formed by the α decay of ^{149}Tb and was prepared from the terbium fraction of tantalum target irradiated with 660-MeV protons. A new version for the level scheme of ^{145}Sm is suggested. The relative feeding intensities for various levels by electron capture are estimated. Spin and parity of $3/2^+$ for the 1547-keV level were obtained. Considerations were made showing $1/2^+$ or $5/2^+$ as possible spins for the 1435-keV level. Author (NSA)

N66-18917# California Univ., Livermore. Lawrence Radiation Lab.
OXYGEN-18 DIFFUSION IN SURFACE D EFFECTS ON MgO AS REVEALED BY PROTON ACTIVATION
J. Birch Holt and Ralph E. Condit 1 Feb. 1965 22 p refs Presented at the Conf. on the Role of Grain Boundaries and Surfaces in Ceram., Raleigh, N. C.
(Contract W-7405-ENG-48)
(UCRL-7938; CONF-641116-2) CFSTI: HC $1.00/MF $0.50

A study of the effect of surface defects on the self-diffusion of oxygen in MgO is reported. The technique involves exchange with oxygen-18 enriched gas followed by proton bombardment to yield the radioisotope, fluorine-18. This may be treated as a normal radioactive tracer. The penetration distribution of the oxygen isotope is indicated by autoradiography. Preferential diffusion of oxygen down bicrystal grain boundaries is definitely proven. Dislocations introduced by cold working are found to contribute to the overall rate of oxygen diffusion. Surface fractures are shown to be important channels for the rapid movement of oxygen. The implications of these findings are discussed. Author (NSA)

N66-18918# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE OPTIMAL CONDITIONS FOR MEASURING THE ELECTRON ENERGY IN HEAVY-LIQUID BUBBLE CHAMBERS [OPTIMIZATSIYA IZMERENII ENERGII ELEKTRONOV V PUZYR'KOVYKH KAMERAKH S TYAZHELYMI ZHIDKOSTYAMI]
Yu. A. Budagov, A. G. Volod'ko, V. B. Flyagin, and P. V. Shlyapnikov 1965 8 p refs In RUSSIAN
(JINR-P-1971)

It is shown that if the measurement error is included in the uncertainty in the electron momentum the optimal length of the track will increase with increasing electron energy. In this connection the cut-off of the spectrum of the radiation losses is extended to a higher energy region. The formulas for the mean value of the electron momentum and its error are obtained. They prove to be valid for the whole spectrum of possible values of the cut-off threshold. Author (NSA)

N66-18919# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE CLASSIFICATION OF HIGH SPIN MESON RESONANCES IN THE SU(6) SYMMETRY [O KLASSIFIKATSII MEZONNYKH REZONANSOV S VYSSHIMI SPINAMI V TEORII SIMMETRII SU(6)]
Wong-Duc Dao and Qui-Tu Pham 1965 7 p refs In RUSSIAN
(JINR-P-2034)

A 189-plet in SU(6) symmetry is considered. The values of the mixing parameters are obtained. The mass splitting is studied. Author (NSA)

N66-18920# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE POSSIBILITY OF STUDYING HIGH ENERGY WEAK INTERACTIONS BY MEANS OF INELASTIC πN COLLISIONS [O VOZMOZHNOSTI IZUCHENIYA SLABYKH VZAIMODEISTVII PRI VYSOKIKH ENERGIYAKH S POMOSHCH'YU NEUPRUPRUGIKH π-N STOLKNOVENII]
N. F. Truskova 1965 5 p refs In RUSSIAN
(JINR-P-19799)

A choice of the most interesting cases of $\pi+N \rightarrow e+\nu+N+n\pi$ interactions is suggested, using the Treiman-Yang criterion. The corresponding one-pole diagrams are estimated at different collision energies. Author (NSA)

N66-18921# Los Alamos Scientific Lab., N. Mex.
ON THE PROPER USE OF TRANSFORMATIONS OF LOG NORMAL FUNCTIONS IN SMALL PARTICLE STATISTICS
A. Goldman, H. D. Lewis, and R. H. Moore 9 Jul. 1965 32 p refs
(Contract W-7405-ENG-36)
(LA-3262) CFSTI: HC $2.00/MF $0.50

A standard notation is suggested for use in all fields concerned with small particle data analysis. The representation of particle size data by various forms of the log normal function is discussed and related to methods of particle size measurement. Transformations among parameters defining the functions are discussed, and the general functional relationships are developed and listed in tabular form. The use of the proper parameters for data comparisons or for distribution definition is emphasized. Author (NSA)

N66-18922# Harvard Univ., Cambridge, Mass. Cambridge Electron. Accelerator.
ON SYNCHROTRON RADIATION PRODUCED PHOTO-ELECTRONS FROM COPPER
G. E. Fischer and R. A. Mack 28 Feb. 1965 29 p refs
(Contract AT(30-1)-2076)
(CEAL-1017) CFSTI: HC $2.00/MF $0.50

The absolute quantum efficiency of photoelectron production from copper was measured in a hitherto inaccessible photon energy region using the broad spectrum of polarized synchrotron radiation from the Cambridge Electron Accelerator. The results, believed accurate to within $\pm 10\%$, have application in the design of vacuum systems and beam current monitors for high current storage rings. The measurements were carried out under ultra-high vacuum conditions. Energy distributions of electrons resulting from photon spectra of various characteristic energies are presented. In the regions of photon energy below 50 eV and above 1 keV where data of previous investigators exist qualitative agreement of yield and angular dependence is found. Author (NSA)

N66-18923# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON RELATIVISTIC THREE-BODY PROBLEM, II [O RELYATIVISTSKOI ZADACHE TREKH TEL, II]
D. Stoyanov and V. P. Shelest 1965 14 p refs In RUSSIAN
(JINR-P-2066)

Equations were obtained for the matrix elements of the scattering amplitudes in the relativistic three-body problem. The approximations for these elements were considered in the cases of strong and weak couplings in the two-body bound state. Author (NSA)

N66-18925# California Univ., Berkeley. Lawrence Radiation Lab.

ON THE CLUSTER STRUCTURE OF THE S MATRIX

James Hamilton Crichton (Ph.D. Thesis) 9 Feb. 1965 132 p refs

(Contract W-7405-ENG-48)

(UCRL-11961) CFSTI: HC $4.00/MF $1.00

Conditions imposed on the S matrix by the requirement that interactions between elementary particles be of short range are studied. Two distinct properties of elementary-particle interactions, so-called cluster properties, are considered specifically: that interactions between particles proceed independently of the presence of other particles far away in space and time; and that multiparticle scattering processes occur predominantly by means of a freely propagating particle connecting, in a causal way, successive scattering processes that involve fewer particles. These properties are formulated as limiting equations involving plane-wave S-matrix elements. These equations imply a structure in the S matrix, which is denoted the cluster structure. The independence of the cluster properties from the usually-postulated properties of the S matrix, namely Lorentz invariance and unitarity, is shown. The S operators obtained from the Feynman perturbation theory and from the LSY formalism are shown to satisfy both cluster properties. It is claimed that any realistic theory of elementary-particle interactions must satisfy these properties. Author (NSA)

N66-18930# International Centre for Theoretical Physics, Trieste (Italy).

THEORY OF GROUPS AND THE SYMMETRY PHYSICIST

Abdus Salam Jul. 1965 20 p Presented at the Centenary Meeting of the London Mathematical Soc. 14 Jul. 1965

(IC/65/70)

Recent successes of the group theory method in classification schemes for elementary particles are pointed out. Particular problems in the representation theory of non-compact groups are discussed. The overall picture of group theory for symmetry physics is discussed. NSA

N66-18933# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

SCATTERING OF 4 Gev/c NEGATIVE PION ON ELECTRONS [RASSEYANIE π^--MEZONOV S IMPUL'SOM 4 Gev/c NA ELEKTRONAKH]

V. G. Grishin, E. P. Kistenev, and Mu Tzung 1965 10 p refs In RUSSIAN

(JINR-P-2162)

The scattering of 4-BeV/c negative pions on electrons was studied. The composition of the beam of primary particles incident on the chamber was determined. The total contamination of muons and electrons in the beam was found to be (103 ±2.1)%. The differential π_e-scattering cross section was obtained, in agreement with the results of the theoretical calculation for the pion scattering on the point electron. A conclusion can be drawn that $r_\pi \leq 6.6 \cdot 10^{-13}$cm. Author (NSA)

N66-18934# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ELECTROMAGNETIC PROPERTIES OF REPRESENTATION 70 IN THE SU(6)-SCHEME [ELEKTROMAGNITIYE SVOISTUA PREDSTAVLENIYA 70 V SKHEME SU(6)]

Kao Ti and L. G. Tkachev 1965 11 p refs In RUSSIAN

(JINR-P-2130)

The electromagnetic current of the 70-plet is obtained under the assumption that it is transformed as a representation 35 of the group SU(6). Its reduction with respect to the subgroup SU(3)×SU(2) is used to single out the electric and magnetic components of the current. It is obtained that the magnetic moments of the particles of the 70-plet are expressed through one constant. Some of the relations between the magnetic moments are indicated. Another method of getting these relations with the help of the magnetic moment operator is considered. Author (NSA)

N66-18935# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

AN ACCOUNT OF ENERGY AND MOMENTUM CONSERVATION LAWS IN ELASTIC INTERACTIONS IN THE MONTE-CARLO METHOD [UCHET ZAKONOV SOKHRANENIYA ENERGII I IMPUL'SA V NEUPRUGIKH VZRIMODEISTVIYAKH V METODE MONTE-KARLO]

V. M. Mal'tsev and I. I. P'yanov 1965 15 p refs In RUSSIAN

(JINR-P-2140)

A method is given of finding the magnitudes and directions of momenta of n particles emitted in the process of the inelastic interaction of two particles. This method assumes the use of experimental data on the momentum and angular distributions of particles. It is immediately applicable for calculating the intranuclear cascade. Author (NSA)

N66-18936# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

GROUP SU(3) IN THE ELEMENTARY PARTICLE THEORY I: STRONG AND ELECTROMAGNETIC INTERACTIONS (REVIEW) [GRUPPA SU(3) V TEORII ELEMENTARNYKH CHASTITS. I: SIL'NYE I ELEKTROMAGNITYNE VZAIMODEISTVIYA (OBZOR)]

V. G. Kadyshevskii and R. M. Muradyan 1965 36 p refs In RUSSIAN

(JINR-P-2124)

A review of the lectures given in the autumn of 1964 at a special seminar devoted to the problems of unitary symmetry is presented. Applications of the group SU(3) to the theory of strong and electromagnetic interactions are considered. The exposition of the material is given on the basis of the unified method—the Clebsch-Gordan expansion and Wigner-Eckart theorem. Author (NSA)

N66-18937# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ITERATION METHOD IN NONRENORMALIZABLE FIELD THEORY

B. A. Arbuzov and A. T. Filippov 1965 15 p refs

(JINR-E-2120)

The iteration method in the nonrenomalizable theory is considered. The linear equation for the vertex in the theory of the interaction between scalar particles and vector ones is taken as an example. The convergence of the iteration procedure and the applicability of the Fredholm method to the full integral equation is provided by the correct choice of the zero approximation. The simple modification of perturbation theory enables one to find the expansion of the vertex in powers of the coupling constant λ and of log ln λ^2. Author (NSA)

N66-18938# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

MASS RENORMALIZATION IN BROKEN SYMMETRY [PERENORMIROVKA MASSY V TEORII NARVSHENNOI SIMMETRII SL(6)]

Nguyen van Hieu 1965 12 p refs In RUSSIAN

(JINR-P-2080)

The problem of mass renormalization in the theory of SL(6) symmetry is treated in the framework of Lagrangian formalism. Author (NSA)

N66-18946# European Organization for Nuclear Research, Geneva (Switzerland).

PARTICLE SEPARATOR BASED ON THE IDENTIFICATION BY A DISK [SEPARATEUR DE PARTICULES BASE SUR L'IDENTIFICATION PAR UN DISC]

R. Meunier, M. Spighel, J. P. Stroot, and P. Duteil 13 Jul. 1965 14 p refs In FRENCH

(CERN-65-27)

A method is proposed for separating particles at high energies. The method uses the identification of the particles by a gaseous disk Cherenkov counter and separation by pulsed electric deflection. A possible schematic representation is given. The magnetic delay channel, the acceptance of a disk separator, the characteristics of the electric deflection, and characteristics of the disk are discussed. The delays in the identification are considered. The advantages of this system for the separation of particles are described. It is concluded that the development of such a particle separator is feasible at present. NSA

N66-18948# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RADIATION DAMAGE IN MOLYBDENUM AFTER HIGH NEUTRON EXPOSURE

B. Mastel, J. L. Brimhall, and T. K. Bierlein 29 Jul. 1965 9 p Submitted for Publication

(Contract AT(45-1)-1830)

(BNWL-SA-151) CFSTI: HC $1.00/MF $0.50

A brief review is given of the effects of short neutron exposures (10^{19} nvt) on molybdenum containing <10 ppm and 150 ppm carbon. In contrast to the low exposures, the high exposure (10^{20} nvt) gave similar results on all samples. The defect clusters and dislocations in the microstructures are discussed. The effects of annealing at 575° and 750°C were studied. NSA

N66-18949# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).

THE REACTION ^{7}Li(P,T)^{6}Li AND ^{6}Li (α,T)^{7}BE [REAKTSII ^{7}Li(P,T)^{6}Li I ^{6}Li(α,T)^{7}BE]

A. A. Ogloblin and V. I. Chuev 1965 16 p refs In RUSSIAN

(IAE-836)

The differential cross sections of the reaction ^{2}Li(p,t)^{5}Li at E_p=16.6 Mev and ^{6}Li(α,t)^{7}Be at E_α=40 Mev were measured. Comparison of the (p,t) reaction on ^{7}Li with the (n,t) reactions on ^{6}Li and ^{7}Li testifies in favor of the triton knockout mechanism in the interaction of protons and neutrons with ^{7}Li. A ^{7}Be level with energy 5.0 ±0.3 Mev was observed in the reaction ^{6}Li(α,t)^{7}Be. The excitation of this state and also of the 4.53-Mev level proceeds roughly with the same probability as of the first two states of ^{7}Be. In this respect the reaction (α,t) on ^{6}Li strongly differs from the (d,p) reaction. An evaluation of the results obtained from the point of view of the dispersion theory of direct processes is presented. Established triangle diagrams can apparently be correlated with the reactions studied. However, a qualitative explanation of the experimental data encounters some difficulties. Author (NSA)

N66-18950# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

A REMARK CONCERNING UNITING THE POINCARE GROUP AND INTERNAL SYMMETRIES [ZAMECHANIE K ODNOI VOZMOZHNOSTI OB'EDINENIYA GRUPPY PUANKARE I GRUPPY VNUTRENNIKH SIMMETRII]

V. I. Kolomytsev and D. G. Fakirov 1965 9 p refs In RUSSIAN

(JINR-P-2107)

A possibility of uniting the Poincaré group L and internal symmetries S is considered. The work is essentially a continuation of the ideas of Ottoson, Kihlberg, and Nissor. Nontrivial mass relations are obtained. Author (NSA)

N66-18952# International Centre for Theoretical Physics, Trieste (Italy).

RELATIVISTIC SYMMETRIES

C. Fronsdal Jul. 1965 31 p refs Presented at the Seminar on High Energy Phys. and Elementary Particles, Trieste Submitted for Publication

(IC/65/68; CONF-650553-2)

A theory is described which allows the calculation of a complete set of vertex functions and scattering amplitudes for strong interactions (for every energy and momentum transfer). The structure and representations of generalized Poincaré groups are discussed. The application of SL(6,c) to elementary particles is considered. NSA

N66-18953# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

REAL PART OF THE ELASTIC P-P SCATTERING AMPLITUDE AT 2, 4, 6, 8, AND 10 GEV [VESHCHESTVENNAYA CHAST AMPLITUDY UPRUGOGO P-P-RASSEYANIYA PRI ENERGIYAKH 2, 4, 6, 8, I 10 GEV]

N. Dalkhazhav, A. Zlateva, L. F. Kirillova et al 1965 5 p refs In RUSSIAN

(JINR-P-2336)

The results of measurements of the real part of elastic p-p scattering at 4 Bev are presented, as well as more accurate data at energies of 2, 6, 8, and 10 Bev (the data were analyzed with account of the relativistic corrections). The differential cross section was measured in the range $0.003 < |t| < 0.2$ Bev/c^2. Author (NSA)

N66-18957# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE ρ-MESON PEAK SHIFT IN DOUBLE PHOTOPRODUCTION [O SDVIGE ρ-MESONNOGO PIKA V DUOINOM FOTOROZHDENII]

L. D. Solov'ev 1965 8 p refs In RUSSIAN Submitted for Publication

(JINR-P-2286)

It is shown that the shift of the meson (ρ) peak in double photoproduction may have a dynamical origin. The importance of an experimental study of the $\gamma\pi \to \pi\pi$ reaction is emphasized. Author (NSA)

N66-18958# Harvard Univ., Cambridge, Mass. Dept. of Physics.

ON THE ELECTROMAGNETIC FORM FACTORS OF THE NEUTRON

John Ray Dunning, Jr. (Ph.D. Thesis) Nov. 1964 140 p refs

(Contract AT(30-1)-2752)

(HUX-2752-9) CFSTI: HC $4.00/MF $1.00

The cross section for inelastic electron–deuteron scattering was measured in the four momentum transfer region corresponding to q^2=0.389 to 6.81 (BeV/c)^2 (a^2=10 to 175 f^{-2}). A liquid deuterium target was used in the internal beam of the Cambridge Electron Accelerator. The scattered electrons were detected with a spectrometer of 6.94% momentum acceptance centered on the quasi-elastic maximum. At q^2=0.389 to 1.17 (BeV/c)^2 and forward scattering angles the quasi-elastic recoil protons were also detected. An impulse approximation model for electron–deuteron scattering in the form given by Durand was used to interpret the deuterium cross sections as the sum of free proton and free

neutron scattering cross sections. Using elastic electron–proton scattering cross sections obtained with a hydrogen target and the Rosenbluth equation, neutron form factors were obtained at q^2=0.389, 0.623, 0.857, 1.17 and 1.75 $(BeV/c)^2$. Upper limits on the form factors were extracted from the q^2=2.92, 3.89, and 6.81 $(BeV/c)^2$ data. Author (NSA)

N66-18959# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
ON PROGRAMS FOR SOLUTION OF NEUTRON PHYSICS PROBLEMS WITH THE HELP OF MONTE-CARLO METHOD [UNTERPROGRAMME ZUR LOESUNG NEUTRONENPHYSIKALISCHER PROBLEME MIT HILFE DER MONTE-CARLO-METHODE]
Ulrich Moeller Feb. 1965 19 p refs In GERMAN
(KFK-298)

Within the framework of a study for the development of a general Monte Carlo code for reactor physics investigations, a description is given of two auxiliary programs used. The first is a realization of distributions of neutron transport for Monte Carlo problems. For the treatment of neutron transport using the Monte Carlo method, random samples of a series of distributions defined by the integral core are necessary. Methods for the realization of all distributions necessary for neutron transport were given. The methods used were all selected with respect to a decimal computer. Effective cross sections for the Monte Carlo problems were also considered. For the solution of the neutron transport equation used in the Monte Carlo method, the cross section as a stable function of the neutron energy is necessary; a scheme is given for the solution of this problem. An IBM-7070 program is described with which, from the neutron energy, the temperature of the material, and a list of isotopes and their densities (atoms/cm^3, the microscopic cross sections in cm^{-1} (capture, elastic scattering, inelastic scattering, fission, and (n,2n) reactions) can be calculated for each isotope given. Constituents of the program are the nuclear data such as resonance parameters, atomiv weights, etc. In energy ranges in which the thermal motion of the nucleus plays a role, the cross sections averaged over a Maxwell spectrum of the nuclear velocities are given. The cross sections calculated in the area of statistical resonances are, in the statistical sense, random numbers. In the energy range in which only measurement values of the cross section are present, polynomials were used. Author (NSA)

N66-18960# Brookhaven National Lab., Upton, N. Y.
ORIENTED NUCLEI
Vance L. Sailor 14 Oct. 1964 16 p refs Brookhaven Lecture Ser. No. 40
(Contract AT(30-2)-GEN-16)
(BNL-903) CFSTI: HC $1.00/MF $0.50

The manner in which nuclear spin and moments behave in an external field to produce nuclear orientation is described, and dynamic and static methods of orientation are reviewed. The details of static-polarization orientation, produced by thermodynamic equilibrium at very low temperatures are discussed. Experiments with polarized nuclei and polarized neutron beams are described, considering the use of the neutron cross sections as a function of energy for determining the assignment of the spin quantum number J to various resonance states. NSA

N66-18961# Iowa State Univ. of Science and Technology, Ames.
PHOTODISINTEGRATION OF CALCIUM-40
David Walter Anderson (Ph.D. Thesis) Jul. 1965 147 p refs (Contract W-7405-ENG-82)
(IS-T-28) CFSTI: HC $4.00/MF $1.00

The bremsstrahlung beam from the Iowa State University electron synchrotron was used to study the photodisintegration of ^{40}Ca to 65 Mev. A sample of calcium metal was bombarded and the positron activities produced were counted using NaI scintillation detectors and a multichannel analyzer. The yield from the one second activities, mainly due to the reactions ^{40}Ca (γ,n) ^{39}Ca, ^{40}Ca (γ,pn) ^{39}K and ^{40}Ca (γ,2n) ^{38}Ca was separated from the yield due to longer lived activities. Analysis for the cross section using the least structure technique shows seven resonances in the region above the giant resonance. The resonance energies are 28.4 ±0.5, 34.7 ±0.6, 39.7 ±1.3, 43.1 ±0.4, 48.3 ±0.3, 54.5 ±0.3, and 60.0 ±1.0 MeV. Author (NSA)

N66-18964# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.
SEARCH FOR ANOMALOUS π^0 PRODUCTION IN 24-GEV PP COLLISIONS
J. Cohen and E. M. Friedlaender Nov. 1964 9 p
(IFA-CR-50)

An attempt was made to detect in p-p interactions a lack of photons similar to that reported in π-p interactions. A statistical procedure is developed for predicting average numbers of neutral secondaries starting from observed characteristics of the charged prongs and isospin conservation. After suitable corrections, 18 detected e^+e^- pairs associated with 738 inelastic 24 Bev pp-stars, were found consistent with predictions based upon isospin conservation and momentum balance. Author (NSA)

N66-19026# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
OPERATING EXPERIENCE WITH THE SEIBERSDORF INHOMOGENEOUS SECTOR FIELD ISOTOPE SEPARATOR
E. Formann, E. Hechtl, G. Lugmair, F. Rudensauer, F. P. Viehbock et al 1965 18 p refs Submitted for Publication
(SGAE-PH-27/1965) CFSTI: HC $1.00/MF $0.50

The Seibersdorf Electromagnetic Isotope Separator has been used during the last 3 years for focused ion currents between 10^{-14}A and 5.10^{-3}A. The work in the low current region concerned investigations on high temperature reactor fuel particles for nuclear spectroscopy. Targets of radioactive isotopes were produced using total ion currents in the order of 100 μA. For neutron cross section measurements in the rare earth region stable isotopes have been separated at ion currents up to 5 mA. Author

N66-19007# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
THE EXTERNAL BEAM OF THE FRASCATI ELECTRON SYNCHROTRON
U. Bizzarri, M. Conte, I. F. Quercia, and A. Turrin 27 Oct. 1965 18 p refs Presented at the 5th Intern. Conf. on High Energy Accelerators, Sep. 1965 *Its* Nota Interna No. 292
(LNF-65/36) CFSTI: HC $1.00/MF $0.50

The beam extraction from the Frascati electron synchrotron has been accomplished by exciting the ν_r=2/3 nonlinear betatron resonance. The second harmonic pattern of the sextupolar perturbation in the guiding field which is required to bring the radial oscillations into resonance is introduced by pulsing currents into few wires of the pole face windings of the four quadrants, connected in a loop. In this way the beam is brought into a two-magnet with septum deflecting channel

and escapes completely from the magnetic field. The extraction channel is described; the preliminary characteristics of the external beam, the results of measurements on the extraction efficiency, and the spill-out times obtained are presented.
Author

N66-19090# European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1965 EASTER SCHOOL FOR PHYSICISTS, VOLUME II
21 Sep. 1965 155 p refs School held at Bad Kreuznach, West Germany, 1–15 Apr. 1965
(CERN-65-24)

CONTENTS:

1. ELECTROMAGNETIC FORM FACTORS OF NUCLEONS P. E. Beckmann (Mainz Univ.) 16 p refs (See N66-19091 09-24)

2. PHOTOPRODUCTION H. Rollnik (Bonn Univ.) 47 p refs (See N66-19092 09-24)

3. SPECIAL MODELS AND PREDICTIONS FOR PION PHOTOPRODUCTION (LOW ENERGIES) G. Hohler (Tech. Hochschule, Karlsruhe) 19 p refs

4. THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON U. Meyer-Berkhout (Deut. Elektronen-Synchrotron) 32 p refs

5. VARIATION OF IONIZATION WITH VELOCITY C. O'Ceallaigh (Dublin Inst. for Advanced Studies) 23 p refs

N66-19091 Mainz Univ. (West Germany). Institut für Theoretische Physik.
ELECTROMAGNETIC FORM FACTORS OF NUCLEONS
P. E. Beckmann *In* CERN Proc. of the 1965 Easter School for Physicists, Vol. II 21 Sep. 1965 16 p refs (See N66-19090 09-24)

Some aspects of the interaction between electrons and nucleons which go beyond quantum electrodynamics are discussed. Electron–proton scattering experiments at large momentum transfer are evaluated and interpreted. The structure of the scattering amplitude; structure of the vertex function, form factors; and the test of validity of the one-photon approximation comprise the three lectures in the presentation. E.E.B.

N66-19092 Bonn Univ. (West Germany). Physikalisches Institut.
PHOTOPRODUCTION
H. Rollnik *In* CERN Proc. of the 1965 Easter School for Physicists, Vol. II 21 Sep. 1965 47 p refs (See N66-19090 09-24)

The strongly interacting particles are discussed in light of photoproduction processes. General ideas of the systematic theory are explained and differences between photoproduction and hadronic two-body processes are emphasized. Kinematics and intermediate states for the two-body processes; relative importance of the different resonances; multipole analysis in the S-channel; detailed theoretical considerations of the S-channel resonances; formulation of the analyticity properties; and the electromagnetic coupling of vector mesons are covered in this lecture series. E.E.B.

N66-19100*# Harvard Coll. Observatory, Cambridge, Mass.
CALCULATIONS OF IONIZATION EQUILIBRIA FOR OXYGEN Scientific Report No. 7
John W. Allen Nov. 1965 24 p refs
(Grant NsG-438; Contract Nonr-1866(48))
(NASA-CR-70922; AD-626165) CFSTI: HC $1.00/MF $0.50
CSCL 20H

Calculations of ionization equilibria are collisional ionization, radiative recombination, and dielectronic recombination. The effects of including dielectronic recombination in the calculations are discussed. Author (TAB)

N66-19127# Uppsala Univ. (Sweden). Quantum Chemistry Group.
COUPLING BETWEEN THE ENERGY GAP AND SINGLE PARTICLE ENERGY FOR NUCLEAR MATTER Scientific Report No. 38
Donald H. Kobe 15 Feb. 1965 23 p refs *Its* Preprint No. 144
(Contract AF 61(052)-701)
(ARL-65-257; AD-625398) CFSTI: HC $1.00/MF $0.50

The principle of compensation of dangerous diagrams is applied to second order which, when combined with the quasi particle self-energy to second order, gives a set of two nonlinear integral equations coupling the energy gap and the single particle energy. These equations are solved for a single state shell type interaction. Some remarks are made about their application to nuclear matter. Author (TAB)

N66-19143# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
EXCITATION CROSS SECTIONS TO THE N=4 LEVELS OF N^V BY ELECTRON IMPACT, COMPUTED WITH THE COULOMB-BORN APPROXIMATION
A. Joanna Taylor and B. A. Lewis Oct. 1965 17 p refs
(AERE-R-5061) HMSO: 2s 6d

Cross section values for the excitation of the N^V ion by electron impact have been calculated in the Coulomb–Born approximation. The transitions considered were those from the n=2 and n=3 states to any of the n=4 states for the energy range between threshold and 435.36 eV. Author

N66-19149# Nuclear Energy Information Center, Warsaw (Poland).
NEW PROPOSALS OF NEUTRINO EXPERIMENTS [NOWE PROPOZYCJE DOSWIADCZEN NEUTRINOWYCH]
B. Kuchowicz 1965 47 p refs
(NEIC-RR-18) CFSTI: HC $2.00/MF $0.50

The results of the most important experiments with free neutrino and antineutrino are listed, also some other experiments being now in progress are mentioned. Four interesting proposals are reviewed: (1) the application of salt deposits as traps for solar neutrinos (the use of Pontecorvo-Davis reaction); (2) the production of an artificial neutrino source by irradiation in a reactor; (3) the use of pulse reactors (also with lithium being irradiated) as sources of antineutrinos; and, (4) the experimental detection of antineutrinos from underground explosions of nuclear devices. Some other ideas dealing with the detection of antineutrinos were also surveyed. Author

N66-19176# European Organization for Nuclear Research, Geneva (Switzerland).
GROUP THEORY AND THE CLASSIFICATION OF THE ELEMENTARY PARTICLES
L. C. Biedenharn 15 Dec. 1965 115 p refs Lectures given in the Acad. Training Programme, CERN, Feb. 1965
(CERN-65-41)

Nuclear structure is discussed in terms of group theory. The use of isospin as the model and variations on the theme of angular momentum; SU(3) symmetry and pattern calculus; the Gell–Mann–Neumann eightfold way—combining of multiplets; SU(3) symmetry applications; and extension of the eightfold way—SU(6) symmetry are the major subjects presented. E.E.B.

N66-19211# AVCO-Everett Research Lab., Everett, Mass.
MONTE CARLO INVESTIGATION OF COUPLED VIBRATIONAL-ROTATIONAL TRANSITION RATES
Benjamin J. Woznick Oct. 1965 23 p refs
(Contracts AF 04(694)-690; DA-01-021-AMC-12005(Z); Proj. Defender)
(AVCO-Everett Res. Rept.-223; AD-474612)

Coupled vibrational-rotational transition rates for diatomic molecules dispersed in a rare gas background are studied using a method based on the variational theory of chemical reactions. Collisions are sampled and the equations of motion are integrated to obtain the energy transfer rates. Approximately 5600 such trajectories were traced for O_2-Ar, O_2-Xe, and 12-Ar systems, and a form for the transition rates in equilibrium was obtained by expanding this rate in a set of basis functions which take into account the strong dependence of the rates on energy transfer. Values of the first few coefficients are given, and the effects of varying the parameters are exhibited.
Author (TAB)

N66-19223# Polish Academy of Sciences, Warsaw.
ROLE OF ATOMIC ELECTRONS IN NUCLEAR TRANSFORMATIONS, VOLUME II
[1963] 304 p refs Proc. of Intern. Conf. Warsaw, 24–28 Sep. 1963
CFSTI: HC $7.00/MF $1.75

CONTENTS:

1. THE MEASUREMENT OF THE L SHELL CONVERSION ELECTRON PARTICLE PARAMETERS IN THE 42 keV E3 TRANSITION OF Ir^{191} B. I. Deutch and P. Hornshoj 19 p refs

2. PARTICLE PARAMETER OF THE 2+→0+ E2 TRANSITION IN Sm^{152} T. M. George and J. H. Hamilton 8 p refs

3. EXPERIMENTAL AND THEORETICAL STUDIES OF L-CONVERSION ELECTRON DIRECTIONAL CORRELATIONS J. E. Thun, S. Tornkvist, F. Falk, and H. Snellman 3 p refs

4. PARTICLE PARAMETER OF THE 2+ →0+ E2 TRANSITION IN Yb^{170} W. L. Croft, B. G. Pettersson, and J. H. Hamilton 8 p refs

5. ANGULAR CORRELATION AND INTERNAL CONVERSION STUDIES IN I^{125} AND I^{127} AND THEIR ANALYSIS USING CORRECTED FORMULAE J. S. Geiger and F. Brown 14 p refs

6. 30.7 KeV ANOMALOUS ELECTRIC DIPOLE TRANSITION Jacques Valentin 6 p refs

7. ANOMALOUS L-SUBSHELL CONVERSION OF SOME HINDERED E1 TRANSITIONS IN THE RARE EARTH REGION C. J. Herrlander and G. T. Ewan 10 p refs

8. ANOMALOUS L-SUBSHELL RATIOS IN MIXED M1-E2 TRANSITIONS T. Novakov, J. M. Hollander, and R. L. Graham 6 p refs

9. E2 CONVERSION COEFFICIENTS IN Cd^{110} AND Xe^{132} W. B. Newbolt, H. W. Boyd, and J. H. Hamilton 13 p refs

10. E2 CONVERSION COEFFICIENTS IN ^{152}Sm, ^{154}Gd AND ^{160}Dy J. F. W. Jansen, J. H. Hamilton, and E. F. Zganjar 14 p refs

11. K-SHELL CONVERSION COEFFICIENTS FOR PURE E2 TRANSITIONS IN SOME DEFORMED NUCLEI B. V. Thosar, M. C. Joshi, R. P. Sharma, and K. G. Prasad 7 p refs

12. THE K-CONVERSION COEFFICIENT OF THE 412 keV E2 TRANSITION IN ^{198}Hg W. H. G. Lewin, B. van Nooijen, C. W. E. van Eijk, and A. H. Wapstra 15 p refs

13. AN EXPERIMENTAL STUDY OF THE K-CONVERSION PROCESS OF THE 412 keV E2 TRANSITION IN Hg 198 B. G. Pettersson and L. Holmberg 7 p refs

14. A SEARCH FOR TWO-QUANTUM DECAY BY DOUBLE INTERNAL CONVERSION IN THE DECAY OF In^{114m} P. Kleinheins, L. Samuelsson, R. Vukanovic, and K. Siegbaan 27 p refs

15. THE REPRESENTATION, IN PHOTOELECTRIC ANGULAR DISTRIBUTIONS, OF PHOTOELECTRON SCATTERING AND THE CONSEQUENCES FOR THE DETERMINATION OF INTERNAL CONVERSION COEFFICIENTS BY THE IEC METHOD Solve Hultberg and Peter Erman 5 p refs

16. APPLICATION TO THE LENS TYPE SPECTROMETER OF THE INTERNAL–EXTERNAL CONVERSION (IEC) METHOD FOR THE DETERMINATION OF INTERNAL CONVERSION COEFFICIENTS S. Hultberg, J. H. Hamilton, and J. Sistler 4 p refs

17. A PRECISION MEASUREMENT OF $(\alpha_2)_K$ OF THE 412 keV TRANSITION IN Hg^{198} AND A HIGH RESOLUTION STUDY OF THE 412 keV ANGULAR DISTRIBUTION OF GOLD K-SHELL PHOTOELECTRONS Karl-Erik Bergkvist and Solve Hultberg 5 p refs

18. SPECIAL METHODS IN THE ANALYSIS OF CONVERSION ELECTRON SPECTRA Albert Allen Bartlett 65 p refs

19. CAPTURE OF OUTER ORBITAL ELECTRONS Barol L. Robinson 10 p refs

20. EXCHANGE AND OVERLAP EFFECTS IN CAPTURE RATIOS John N. Bahcall 9 p refs

21. SOME ALLOWED K-CAPTURE TO POSITION RATIOS J. Konijn, S. A. de Wit, and A. H. Wapstra 14 p refs

22. THE RATIO OF K-CAPTURE TO POSITRON EMISSION IN THE DECAY OF NITROGEN 13 K. W. D. Ledingham, J. A. Payne, and R. W. P. Drever 7 p ref

23. COMPARISON OF RECENT PRECISION RESULTS OF ORBITAL ELECTRON CAPTURE RATIOS WITH THEORY R. W. Fink 4 p refs

24. MEASUREMENT OF THE M/L-CAPTURE RATIO IN 30 MILLION YEAR Pb^{205} DECAY WITH THE MULTIWIRE PROPORTIONAL COUNTER R. B. Moler and R. W. Fink 2 p refs

N66-19242# Uppsala Univ. (Sweden). Quantum Chemistry Group.
THE INTERACTION POTENTIAL SURFACE FOR H_3
Frank E. Harris, David A. Micha, and Herbert A. Pohl 15 Jan. 1965 17 p refs *Its* Preprint No. 142
(Contract AF 61(052)-701)
(SR-36; ARL-65-251; AD-625214) CFSTI: HC $1.00/MF $0.50

Calculations were made on the properties of the triatomic hydrogen, H_3, system interaction using a split-shell molecular orbital wave function based on one orbital per atomic center. Several integral approximations were used to simplify computation. The results obtained refer to both the intermediate state parameters and to the interaction potential surface, especially including the transition region between short range (chemical binding) potential and long range potential.
Author (TAB)

N66-19349* California Univ., Berkeley. Lawrence Radiation Lab.
PION STUDIES WITH SILICON DETECTORS
Mudundi R. Raju, Henry Aceto, and Chaim Richman (Texas Univ., Dallas) *In its* Biol. and Med., Spring 1965 [1965] p 84–99 refs Submitted for Publication (See N66-19346 09-04)
CFSTI: HC $5.00/MF $1.25

This study was initiated because of recent interest in negative pions for therapeutic applications. When a negative pion is brought to rest in a medium, say tissue, it may be captured

by a constituent nuclei, resulting in "star" events. In such interactions about 20% of the total rest energy of the π^- meson, that is, approximately 30 MeV, appears in the form of α particles and protons with ranges less than 1 mm in biological tissue. It is very important to know the energy distribution of this pion star. Semiconductor detectors are used in the present investigation to look at the pion beam passing through various thicknesses of absorbing material and finally to measure the energy distribution of negative pion stars in silicon. Measurements were made of the most probable energy loss in silicon for pions of energies extending from 365 MeV to 50 MeV. The results agree within 2% with the theoretical values. The behavior of the pion beam with its inherent muon and electron contaminants, as it passes through various thicknesses of absorbing material, is displayed. Finally the energy distribution of negative pion stars in silicon is measured, and is found to be a constantly decreasing function with increasing energy, with the high-energy tail extending beyond 60 MeV. Author

N66-19350* California Univ., Berkeley. Lawrence Radiation Lab.

FLUCTUATIONS OF ENERGY LOSS BY CHARGED PARTICLES IN SILICON DETECTORS

Howard D. Maccabee and Mudundi R. Raju *In its* Biol. and Med., Spring 1965 [1965] p 103–106 refs (See N66-19346 09-04) CFSTI:HC $5.00/MF $1.25

The aim of this investigation is to use thick lithium-drifted semiconductor detectors for a detailed experimental investigation of fluctuations of energy loss by particles of high and intermediate energy. Special consideration is being given to situations of significance for biomedical irradiation. Author

N66-19356* California Univ., Berkeley. Lawrence Radiation Lab.

HEAVY-PARTICLE STUDIES WITH SILICON DETECTORS

Mudundi R. Raju *In its* Biol. and Med., Fall 1965 [1966] p 6–14 refs (See N66-19354 09-04) CFSTI: HC $4.00/MF $1.00

The response of lithium-drifted silicon detectors was studied with a view to determining applications of these detectors to radiobiologic problems. Until recently these detectors had only limited applications because they were available only with limited thickness. Now the technology has been improved, and detectors several millimeters thick are available. The availability of these detectors has revolutionized radiation detection and spectroscopy. The use of a solid as a detector is very attractive because the sensitive layer can be quite thin and yet possess a high stopping power. Another advantage is the low energy used to produce one hole-electron pair (3.6 eV in silicon): nearly ten times as much charge is produced for a given energy loss in silicon as in gas, which leads to small statistical fluctuations in the number of pairs and to improved energy resolution over gas-filled counters. The intrinsically high speed of the device is due to the high mobility of the carriers in the electric field, coupled with the short distance between electrodes. An attractive feature of these detectors is that they operate as true energy devices and do not exhibit saturation effects as do scintillation counters. In this investigation the response of these detectors to high-energy alpha and proton beams, and the intermediate energies, obtained by placing absorbing materials in the path of the primary beam, was studied. Author

N66-19377# Uppsala Univ. (Sweden). Quantum Chemistry Group.

APPLICATION OF THE HELLMANN–FEYNMAN AND VIRIAL THEOREMS TO THE THEORETICAL CALCULATION OF MOLECULAR POTENTIAL CONSTANTS

Richard Schwendeman 1 Jun. 1965 28 p refs *Its* Preprint No. 151
(Contract AF 61(052)-701)
(SR-45; ARL-65-276; AD-626936) CFSTI: HC $2.00/MF $0.50

The Hellmann-Feynman theorem is discussed with emphasis on the importance of the choice of integration variables to the appearance of the equations, the stability of the wave functions, and the reliability of calculations. The Hellman-Feynman expression for the z-component of the force on a single nucleus is differentiated successively to obtain expressions which are related to the harmonic and anharmonic potential constants in a molecule. The method used to simplify the differentiations is also used to derive two expressions for the field gradient part of the nuclear quadrupole coupling constant; the two expressions involve only convergent integrals. The virial-theorem expression for diatomic molecules is differentiated to obtain equations for the cubic and quartic potential constants and for the Dunham constants. Application of the equations to quantum-chemical calculation of the potential constants is discussed. Author (TAB)

N66-19410# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.

SPUTTERING Annual Report, 1 Nov. 1964–31 Oct. 1965

R. V. Stuart and G. K. Wehner 27 Dec. 1965 46 p refs (Contract Nonr-1589(15))
(LSI-2926; AD-625776) CFSTI: HC $2.00/MF $0.50

Measurement of the Doppler shift of light emitted in the direction of travel by sputtered Mo and Ag atoms have verified time-of-flight measurements of ejection energies of sputtered atoms. The Doppler shift measurements, being dependent on the distribution of energies of sputtered atoms, provide much stronger substantiation of time-of-flight data than that provided by agreement with average ejection energy measurements. The Doppler shift measurements have substantiated not only numerical values of ejection energies but also the shape of the distribution function. The dependence of the high energy tail on bombarding ion energy and the lack of dependence of the most probable ejection energy on bombarding ion energy are also verified by the Doppler shift measurements. Author (TAB)

N66-19559# Armed Forces Radiobiology Research Inst., Bethesda, Md.

THE LOW-ENERGY COMPONENT OF THE TOTAL DOSE FOR DEEP GAMMA PENETRATIONS IN AIR AND WATER

C. W. Garrett Nov. 1965 17 p refs Presented at the Meeting of the Am. Nucl. Soc., Washington, D. C., Winter 1965
(AFRRI-TN-65-2; AD-625714) CFSTI: HC $1.00/MF $0.50

A difference of a factor of two in the buildup factors for infinite water and infinite air at deep penetration distances (e.g., 10 mean free paths) for point isotropic cobalt-60 sources is noted. One possible cause for the discrepancy is the improper accounting of the dose delivered by low-energy photons (energies less than 100 keV) in the infinite air case, which was treated by a Monte Carlo analysis. The possible effects of this cause are presented, showing that lack of present knowledge of the differential number flux density for low-energy photons diffusing in low-Z materials leads to great uncertainty in the fraction of the total dose delivered by the low-energy component. Experimental data indicate that essentially all of the discrepancy between the water and air buildup factors could be attributed to a neglect of the low-energy dose. On the other hand, recent Monte Carlo calculation of the low-energy flux suggests that the cause for the discrepancy must be accounted for by other, at present undetermined, factors. Author (TAB)

N66-19690*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
MEASUREMENT OF NEUTRON SPECTRA IN LIQUID HYDROGEN Quarterly Progress Report, Period Ending Dec. 17, 1965
G. D. Trimble and A. E. Profio 7 Jan. 1966 46 p refs
(Contract NAS3-6217)
(NASA-CR-54889; GA-6897) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A description is given of the liquid hydrogen facility which consists of the following components: (1) a liquid hydrogen cryostat; (2) a valve package; (3) connections from the liquid hydrogen cryostat to the valve package, such as the flexible vent lines and the vacuum jacketed fill and dump line; (4) gas cylinders and plumbing for distributing the gaseous nitrogen or gaseous helium for purging, commonly referred to as the "bottle farm"; (5) transfer lines from the valve package to the liquid hydrogen supply dewar; (6) the remote control console; and (7) the support structure for the liquid hydrogen cryostat. Also discussed are hydrogen sniffers, which are electronic devices that forewarn that leaks are present in the system before hydrogen concentration is at the explosive level. A water cooled fast neutron source was constructed to replace the air cooled isotropic fast neutron source previously used. A thorough checkout of each component of the liquid hydrogen facility was made. Liquid nitrogen was used in this checkout because it is the most logical cryogenic fluid nearest to liquid hydrogen temperature. Theoretical calculations were also made in the fast neutron region which extends from 15 to 0.5 MeV.
R.R.D.

N66-19720# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ASYMPTOTIC PROPERTIES OF THE POTENTIALS IN THE INVERSE-SCATTERING PROBLEM AT FIXED ENERGY
Pierre C. Sabatier Dec. 1965 54 p refs
(Th/116) CFSTI: HC $3.00/MF $0.50

The problem of finding a nonrelativistic central potential from a knowledge of all the phase-shifts at one energy was previously shown by R. G. Newton to reduce to the inversion of a given infinite matrix, M. In the framework of Newton's theory, the solution is not unique but depends on one parameter. In the present work, the inverse matrix is explicitly given, together with the vectors annihilated by M. These enable the construction of all the solutions of the problem. The asymptotic behavior of the equivalent potentials is exhibited, and it is shown that one and only one of them decreases asymptotically faster than $r^{-2+\epsilon}$, provided that the phase-shifts decrease asymptotically faster than $l^{-(3+\epsilon')}$ (for arbitrarily small ϵ, ϵ'). All the other equivalent potentials have an oscillating tail damped by a factor $r^{-3/2}$. The transparent potentials, which give a phase-shift equal to zero at one energy, are also studied. In subsequent publications, analytic continuation of the potentials in the r plane and of the Jost function in the angular momentum complex plane will be studied.
Author

N66-19723 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
ACTIVITIES OF THE NATIONAL LABORATORY OF FRASCATI, 1 JULY 1964–30 JUNE 1965 [ATTIVITA DEI LABORATORI NAZIONALDI DI FRASCATI DAL I LUGLIO 1964 AL 30 GIUGNO 1965]
Oct. 1965 34 p refs In ITALIAN *Its* Notiziario No. 15
(LNF-65/41) CFSTI: HC $2.00/MF $0.50

Research activities are reported in the following areas: (1) high energy physics; (2) linear accelerator experiments; (3) synchrotron experiments; (4) cryogenics; (5) magnetism; (6) electronics; (7) nuclear technology; (8) dosimetry; and (9) computer programming. A bibliography is included.
Transl. by D.T.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-18496# Yale Univ., New Haven, Conn.
[THEORETICAL PROBLEMS IN PLASMA PHYSICS] Progress Report
Henry Margenau 1 Jan. 1966 14 p refs
(Contract Nonr-609(51))
(AD-625429) CFSTI: HC $1.00/MF $0.50

Basic theories for describing the interaction of electromagnetic radiation with plasmas are under study. A generalization of the Prigogine plasma theory is reported, in which an electromagnetic field is included among the constituents of the plasma. Calculations were carried to the 4th order of perturbation theory, and detailed examination of terms revealed the occurrence of infinities which are very similar to those encountered in quantum field theories. Research is also reported on the density distributions of ions, in which the Fokker–Planck collision integral is used to exploit the fact that the deflections are small for ion–atom collisions. In studies on the conductivity of a fully ionized plasma, efforts to generate the shielded Debye potential out of the bare Coulomb force in the kinetic equation are discussed. Consideration is also given to a momentum transfer theorem that may be useful in determining coefficients for the emission and absorption of radiation due to collisions between charged particles and neutral atoms or molecules.
M.G.J.

N66-18502# California Univ., Berkeley. Electronics Research Lab.
PLASMA RESEARCH Quarterly Progress Report, 1 Apr.–30 Jun. 1965
Jun. 1965 65 p refs
(Contract AF 33(615)-1078; Grants AF-AFOSR-139-65; NSF GA-2239)
(QPR-2; AD-625424) CFSTI: HC $3.00/MF $0.75

This research in plasmas is part of an integrated program of research and teaching in the problems of creation, containment, heating, stability, radiation, and measurement of the physical and electromagnetic properties of high- and low-temperature plasmas. The basic high-temperature plasma research facility consists of a 250,000-joule capacitor energy-storage system and related electronic control and safety equipment. This bank operates two basic experiments each of which requires pulse magnetic fields in excess of 50,000 gauss.
TAB

N66-18507# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOURCE OF GAS-DISCHARGE PLASMA
Yu. V. Kuboarev 27 Oct. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 166974 (Appl. No. 818030/26-25, 4 Nov. 1963) 2 p
(FTD-TT-65-806/1+2+4; AD-625789) CFSTI: HC $1.00/MF $0.50

The object of the invention is a source of gas-discharge plasma of continuous action consisting of a hermetically closed ceramic tube located in a nonuniform magnetic field inside of which there is placed a discharge chamber which contains an anode and a cathode of direct incandescence and a system of auxiliary electrodes. For the purpose of increasing the degree of ionization of the gas and the speed of the plasma stream of the source in it on the output, there is located an ionization chamber the housing of which brought a throw-over switch is connected up to the anode and in which there is an inlet opening for the operative gas. Author (TAB)

N66-18529*# California Univ., Berkeley. Space Sciences Lab.
SOLAR SYSTEM MAGNETIC FIELDS AND PLASMAS
John M. Wilcox 24 Nov. 1965 36 p refs Presented at Symp. on the Dyn. of Fluids and Plasmas, Maryland Univ., College Park, 7–9 Oct. 1965 Submitted for Publication
(Grant NsG-243-62; Contract Nonr-3656(26))
(NASA-CR-71038; AD-625178) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The report begins with the magnetic fields observed on the surface of the sun, moves out to interplanetary fields and plasmas and their relation to these solar magnetic fields, and finally come to earth in a plasma physics laboratory. Against this background the report presents some recent results obtained in collaboration with N. F. Ness with the magnetometer experiment on the IMP-1 satellite as supplemented with observations obtained in collaboration with R. Howard with the Mount Wilson Observatory solar magnetograph.
Author (TAB)

N66-18534# Michigan Univ., Ann Arbor.
UNIFIED APPROACH TO EXCITATION PROBLEMS IN COMPRESSIBLE PLASMA
V-K Wu Griffiss AFB, N. Y., RADC, Nov. 1965 227 p refs *Its* Rept.-6663-1-T
(Contract AF 30(602)-3381)
(RADC-TR-65-353; AD-625897) CFSTI: HC $6.00/MF $1.25

This investigation is concerned primarily with the general, unified approach to the solution of excitation problems in a compressible plasma which may be inhomogeneous and include different types of sources, e.g. electric current source, magnetic current source, fluid approach is chosen and is based on the linearized Euler equations of motion and the Maxwell equations. The Maxwell-Euler equations are reformulated through linear operator and generalized transform techniques into an equivalent matrix integral equation, which can be solved recursively for a general linear plasma medium. When the medium is homogeneous, this integral equation has a degenerate kernel and the explicit solution can be easily obtained. A thorough study is given for the excitation of disturbances due to different types of sources in a homogeneous electron plasma externally impressed by a constant magnetic field. The dispersion relations for the three types of waves involved in an electron plasma are studied carefully and a proper terminology introduced. The radiation field is then solved for both two- and three dimensional excitation problems. Equivalence relations between different types of sources are also obtained. The numerical results shows that a large portion of energy radiation is in an acoustic type wave. Author (TAB)

N66-18536# Oxford Univ. (England). Clarendon Lab.
INVESTIGATION OF THE PROPERTIES OF HOT PLASMA GASES AND MEASUREMENT OF GAS TEMPERATURES NEAR SOLID SURFACES Final Scientific Report, 1961–1964
A. von Engel 28 Jan. 1965 14 p refs
(Contract AF 61(052)-495)
(AFML-TR-65-419; AD-625043) CFSTI: HC $1.00/MF $0.50

Studies were made of the methods of gas temperature measurements particularly of a plasma jet where the temperature can be derived from the gas density. One density measurement uses in principle the determination of the range of alpha-particles from a polonium source. Two other methods, one using the Doppler effect of sound and the other using the velocity of a pressure pulse were also discussed. The calorelectric effect was investigated experimentally and theoretically. Its mechanism was suggested supported by measurements of the electron temperature. A study of the ionization in flames led to the conclusion that the electron temperature in flames at atmospheric pressure can exceed markedly that of the neutral gas. As a result of it the large electron concentration in flames may well be caused by electron collisions rather than by a series of processes termed chemi-ionization. The theory of double probes was extended to high gas pressures where the motion of charges is controlled by collision processes such as mobility and diffusion. TAB

N66-18604# Harry Diamond Labs., Inc., Washington, D. C.
MICROWAVE MEASUREMENTS OF THE ELECTROMAGNETIC PROPERTIES OF SHOCKED AIR IN THE RANGE $8 \leq M_s \leq 12$ AND $1 \leq p_1 \leq 20$ MM
Frank L. Tevelow 30 Aug. 1965 72 p refs
(HDL-TR-1301; AD-625945) CFSTI: HC $3.00/MF $0.75

Microwave transmission measurements of the electrical properties of shock-ionized air in the range $8 \leq M_s \leq 12$ and initial pressures of 1, 2, 5, 10, and 20 mm Hg are presented. The test arm of the microwave transmission bridge is X-band waveguide, which passes through the shock tube and has an affixed nozzle to section out a portion of the shocked gas. This gas is constrained to a rectangular cross section and passes through the waveguide where it interacts with the microwave signal. A 1/2-in. and a 1 1/2-in. nozzle are used, and it is shown that nozzle length has a negligible effect on both the ionization rate and the level. The data are presented in terms of dielectric constant, electron density, collision frequency, conductivity, attenuation, and reflection coefficient. The data are compared with results obtained from other experimental methods and discrepancies are noted. Ionization profiles obtained from the microwave measurements at 1 mm agree below $M_s = 11$ with calculations made using the rate program of Garr and Marrone. Evaluation of ionization profiles in terms of rate constants is complicated at all pressures by the effects of accelerating shocks. Author (TAB)

N66-18607# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
SURFACE WAVES AT A PLANE INTERFACE BETWEEN VACUUM AND PLASMA WITH THE MAGNETOSTATIC FIELD NORMAL TO THE INTERFACE
Kondagunta U. Sivaprasad and Sengadu R. Seshadri (Sylvania Elec. Prod., Inc., Waltham, Mass.) Oct. 1965 30 p refs *Its* Phys. Sci. Res. Papers No. 155
(AFCRL-65-753; AD-626144) CFSTI: HC $2.00/MF $0.50

The characteristics of the surface waves sustained by a plane interface which separates semi-infinite regions of vacuum and magnetoionic medium are investigated for the case in

which the magnetostatic field is normal to the interface. It is found that plane surface waves exist if the gyromagnetic frequency is less than the plasma frequency and in the range of frequencies lying between the gyro-magnetic frequency and $1/\sqrt{2}$ times the upper hybrid resonant frequency. The phase velocity of the surface waves is always less than the velocity of electromagnetic waves in free space and it decreases monotonically with the increase in the frequency and goes to zero at $1/\sqrt{2}$ times the upper hybrid resonant frequency. Author (TAB)

N66-18615# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
NONLINEAR MECHANICS OF UNIVERSAL PLASMA INSTABILITIES
Herbert Lashinsky Aug. 1965 20 p refs Presented at the 7th Intern. Conf. on Ionization Phenomena, Belgrade, 22–27 Aug. 1965
(Grant AF-AFOSR-141-65)
(BN-411; AFOSR-65-1737; AD-625033) CFSTI: HC $1.00/MF $0.50

Certain nonlinear mode-competition phenomena observed in experiments on the universal plasma instability in a thermal plasma device (Q-machine) have been analyzed by extending the usual phase-plane methods of nonlinear mechanics, the phase-plane coordinates in this case being the mode energies. Ion Landau damping of the universal instability provides an experimental means for selective control of the mode amplitudes. The results of mode-competition experiments using this technique are in agreement with the theoretical analysis and the relevance of the results to similar phenomena in gas lasers and lumped parameter vacuum-tube circuits is discussed. Author (TAB)

N66-18690# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
IONIZATION MEASUREMENT IN A STREAMER CHAMBER
T. L. Asatiani, K. A. Gazaryan, V. N. Zhmyrov, E. M. Matevosyan, A. A. Nazaryan et al 1965 34 p refs
(JINR-E-2324)

The problems of ionization measurement in a streamer chamber filled with neon are investigated. The ionizing power of protons coming at 90° to the electric field with energies of 660, 106, 57, 47, and 33 MeV was measured with three time values of streamer track formation. The track brightness is shown to serve as a good parameter for measuring ionization in the streamer chamber. The track brightness versus ionization of protons coming at 55–67° to the electric field was measured at 660, 106, and 57 MeV. Ionization in the streamer chamber filled with helium was preliminary measured. Author (NSA)

N66-18706# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems
DISPLACEMENT OF SPARK CHAMBER DISCHARGES IN A MAGNETIC FIELD [SMESHCHENIE RAZRYADOV I SKROVOI KAMERY V MAGNITNOM POLE]
S. M. Korenchenko, A. G. Morozov, and K. G. Nekrasov 1965 12 p refs In RUSSIAN
(JINR-P-2344)

The discharges of the spark chamber placed in a magnetic field are displaced with respect to the ionizing particle track if they are affected by the clearing electric field which is normal to the magnetic field. Using the experimental data of this work obtained with a spark chamber filled with neon and the data of others the dependence of the magnitude of the discharge displacement on the applied fields, on the pulse delay in the chamber supply and on the gas parameters was derived. For noble gases, neon, helium, and their mixtures, good agreement is obtained between the theoretical estimate for the discharge displacement and the experimental data. Author (NSA)

N66-18735# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON SURFACE WAVE IN PLASMA WITH CURRENT OF LIMITED RADIUS [O POVERKHNOSTNOI VOLNE V PLAZME S TOKOM OGRANICHENNOGO RADIUSA]
V. G. Makhan'kov 1965 10 p refs In RUSSIAN
(JINR-P-2353)

For the plasma cord with a current the boundary conditions were obtained which take into account the surface currents. For one particular case the dispersion equation of the surface wave was obtained. The temperature effects are neglected. Author (NSA)

N66-18766# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
TWO-DIMENSIONAL ANALYSIS OF MHD GENERATORS WITH SEGMENTED ELECTRODES
Z. N. Celinski and F. W. Fischer Jan. 1965 80 p refs
(IPP-3/26)

The distribution of electrical parameters in MHD generators was determined by numerical analysis for any channel geometry and any practical Hall parameter. The analysis was limited to generators with a separate electrical circuit for each pair of electrodes. Constant gas-dynamic parameters and constant generator cross section were assumed. A correction factor was calculated, the use of which makes it possible to correct one-dimensional theory equations for two-dimensional effects. Optimum electrode sizes were determined. Author (NSA)

N66-18787# Los Alamos Scientific Lab., N. Mex.
THETA-PINCH SOURCES OF VACUUM ULTRAVIOLET RADIATION
N. J. Peacock, R. D. Cowan, and G. A. Sawyer [1965] 13 p refs Presented at the 7th Intern. Conf. on Phenomena in Ionized Gases, Belgrade
(Contract W-7405-ENG-36)
(LA-DC-7120; CONF-650806-12) CFSTI: HC $1.00/MF $0.50

Theta-pinch plasmas have demonstrated the highest known laboratory temperatures and are thus a convenient source for exciting the spectra of highly stripped ions. Grazing incidence spectrographs were used to study the spectra of highly excited rare gases and of Fe. Some of the iron lines were classified as transitions in Fe VIII–Fe XVI. Author (NSA)

N66-18924# Los Alamos Scientific Lab., N. Mex.
QUANTITATIVE SPECTROSCOPY OF CESIUM PLASMAS
Lewis Agnew and C. Summers [1965] 28 p refs Presented at the 7th Intern. Conf. on Phenomena in Ionized Gases, Belgrade
(Contract W-7405-ENG-36)
(LA-DC-7112; CONF-650806-11) CFSTI: HC $2.00/MF $0.50

Quantitative spectroscopic measurements were made of the line and continuum intensities and line profiles observed in an isothermal cesium plasma oven at plasma conditions up to 2300° K, 6.5 torr and 10^{14} ions/cm^3. Absolute oscillator strengths for 50 lines are given. Results are larger

than Stone's calculated values by approximately 35% for the sharp series and 12% for the diffuse and fundamental series. Radiative recombination cross sections measured for the first two excited states (6P and 5D) are $\sigma_{6P}(v)=3.74\times10^{-6}/v^2$ cm^2 and $\sigma_{5D}(v)=8.3\times10^{-6}/v^2$ cm^2 (v in cm/sec). Widths of Stark-broadened fundamental series lines are in good agreement with theory. Author (NSA)

N66-19068*# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

ELECTRON BEAM COMPRESSION WITH ELECTRIC AND MAGNETIC FIELDS

K. I. Talbot and C. C. Johnson Aug. 1964 14 p refs (Grant NsG-557)

(NASA-CR-70365) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A combined electrostatic and magnetostatic compression system may be used to yield electron beams of very small diameters and very large current and power densities. Analytical results were obtained which give design curves for a minimum ripple beam. Small design error effects in initial beam slope and radius were investigated as well as effects due to thermal velocities and cathode flux. Experimental results were obtained on a perveance 2.4×10^{-6} beam operating at 10 kv. A final beam diameter of .013 inches was obtained in a magnetic field of 7500 gauss. An area compression of 1350:1 was obtained with a final current density at 2000 amps per square centimeter. The beam size was detected by copper collector erosion patterns and holes burned in carbon paper discs. R.N.A.

N66-19146*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

ON THE STATISTICAL MECHANICAL DESCRIPTION OF SCATTERING PROCESSES IN COLLISIONLESS PLASMAS

Michael S. Macrakis [1966] 25 p refs Submitted for Publication

(NASA-TM-X-57266) CFSTI: HC $1.00/MF $0.50 CSCL 20I

By separating the microscopic equations of motion for the particle density and the fields in a plasma into ensemble average and fluctuating parts we have been able to obtain an unambiguous description of scattering of an electromagnetic wave from density fluctuations. The method described can be generalized to include all linear scattering processes in a plasma involving the interaction of transverse and longitudinal waves with fluctuations. Author

N66-19187# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

FINITE RESISTIVITY INSTABILITIES OF A SHEET PINCH

J. Wesson Jun. 1965 21 p refs Submitted for Publication (CLM-P79)

The finite resistivity instabilities of a sheet pinch are studied by numerical analysis in terms of normal modes. Results are obtained for the tearing, ripple and gravitational modes and their dependence on conductivity, wavelength, the gravitational field, the position of $k\cdot B=0$ and the position of the walls. Comparison is made with the results of Furth, Killeen and Rosenbluth. Author

N66-19204# AVCO-Everett Research Lab., Everett, Mass.

LOW FREQUENCY WHISTLER MODE

C. Kennel Jan. 1966 41 p refs (Contract Nonr-2524(00)) (AVCO-Everett Res. Rept.-242; AD-476985)

An expression is obtained for the resonant growth (or damping) of electromagnetic waves propagating at an angle to the magnetic field in a model plasma assumed to have a two component velocity distribution consisting of a dense cold background plasma, which provides the propagation medium, and a diffuse energetic non-thermal tail, which is responsible for resonant particle effects. The low frequency whistler mode is treated in detail. When the energetic resonant electrons have a sufficiently hard energy spectrum, and a pitch angle anisotropy corresponding to more electron energy perpendicular than parallel to the magnetic field, the whistler can be unstable over a significant cone of wave propagation angles to the magnetic field. Detailed computations of this growth rate for various energy and pitch angle distributions are presented as a function of wave normal angle to the field. The unstable cone is small for steep energy distributions—i.e., when the tail is not well populated. For this reason, the whistler is usually thought to be heavily damped in low plasmas.

Author (TAB)

N66-19207# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

A KINETIC THEORY APPROACH TO ELECTROSTATIC PROBES

Eliahu Wasserstrom, C. H. Su, and Ronald F. Probstein May 1964 81 p refs (Contract Nonr-1841(93)) (Publ.-64-5; AD-441796)

Aspherical electrostatic (Langmuir) probe in a slightly ionized plasma is studied from a kinetic theory point of view. The velocity space is divided into two regions along the straight cone tangent to the spherical probe, and different distribution functions are defined in the two regions. On satisfying the two relevant moments of the distribution function, three simultaneous ordinary nonlinear differential equations, which are appropriate to all values of the Debye length, collision mean free path and probe potential, are obtained for determining the ion and electron number densities, and the potential. The equations are first linearized and solved for the case of small probe potential. The general case of arbitrary probe potential drop in the sheath are presented for some representative cases. Many of the results which are obtained do not appear in the original simplified Langmuir model. The modifications required to take into account the curvilinear orbits of the charged particles are discussed.

Author (TAB)

N66-19409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF RETAINING AND ACCUMULATING HIGH TEMPERATURE PLASMA IN A TRAP

S. P. Lomnev, E. B. Pereslavtsev, and V. M. Shatunov 9 Dec. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 167260 (Appl. no. 897246/26-25, 25 Apr. 1963) 2 p (FTD-TT-65-1168/1+2+4; AD-625070) CFSTI: HC $1.00/MF $0.50

The object of invention is a method of retaining and accumulating in a trap high temperature plasma formed by injected particles, for example deutons captured and held by a magnetic field. For the purpose of improving the conditions of the capture and increasing the concentration and particle heating it utilizes a dipole-type magnetic field increasing in time the rate and the magnitude of the growth of which is determined by the parameters of the concrete arrangement.

Author (TAB)

N66-19419# Michigan Univ., Ann Arbor. Electron Physics Lab.

MICROWAVE GENERATION BY MEANS OF INTERACTION WITH ANISOTROPIC MEDIA Quarterly Progress Report No. 1, Jun. 15–Sep. 15, 1965

C. A. Brackett, G. T. Konrad, and J. E. Rowe Oct. 1965 48 p refs *Its* Rept.-1

(Contract DA-28-043-AMC-01315(E))

(ECOM-01315-1-T; AD-626196) CFSTI: HC $2.00/MF $0.50

The equations pertinent to the interaction of an electron beam and a stationary plasma with an electromagnetic wave are derived. The purpose is to investigate, on a small-signal basis, the generation of harmonics in a microwave beam-plasma system. The Boltzmann-Vlasov equation, with a constant viscous damping term to account for electron-neutral collisions, is used and all field quantities are expanded in a power series of an arbitrary expansion parameter E. The coefficients of each power of E are then expanded as harmonic functions in time whose amplitudes are slowly varying functions of position. An approximate set of equations is then given which in principle can be solved by the method of successive approximations. A device for studying amplification and harmonic generation in a beam-plasma system is in the initial design stages. A plasma column contained in a glass tube through which an electron beam is to be passed will ultimately be used. The coupling to the beam-plasma system will be accomplished by means of elliptic cavity couplers. These couplers will be movable for maximum coupling to each of the various harmonic components. The input impedance for a proposed elliptic cavity coupler has been calculated and is presented in this report. Author (TAB)

N66-19522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RADIOFREQUENCY POWER TRANSFER TO ION-CYCLOTRON WAVES IN A COLLISION-FREE MAGNETOPLASMA

Donald R. Sigman Washington, NASA, Mar. 1966 25 p refs (NASA-TN-D-3361) CFSTI: HC $1.00/MF $0.50 CSCL 20I

With the Fourier integral theory developed by T. H. Stix, calculations were made on power transfer from a radiofrequency coil to an ion–cyclotron wave in a cold collisionless cylindrical plasma. The effects of varying parameters such as static magnetic field, electron density, radiofrequency, plasma and coil radius, and wavelength are discussed. It is shown that there is an optimum radiofrequency coil wavelength for maximum power transfer, and curves are presented to facilitate the selection of this wavelength. The importance of placing the radiofrequency coil as close to the plasma as possible is also shown. Finally, a comparison is made between calculations from the above mentioned Fourier integral theory and a former Fourier–Bessel series theory. The two theories are not found to be in agreement. Author

N66-19538*# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.

PULSED ELECTROMAGNETIC GAS ACCELERATION Seventh Semiannual Progress Report, 1 Jul.–31 Dec. 1965

Robert G. Jahn and Woldemar F. von Jaskowsky 1 Jan. 1966 65 p refs *Its* Rept.-634f

(Grant NsG-306-63)

(NASA-CR-71097) CFSTI: HC $3.00/MF $0.75 CSCL 20I

The exhaust of pulsed plasmas to a vacuum was studied photographically and with magnetic probes and ion collectors. A tendency to stabilization of the current patterns in the exhaust plume was observed while the plasma ejection process continued unabated. This conversion from a current sheet "sweeping" mode which initiates the acceleration process, to a steady-flow, magnetogasdynamic pumping mode, suggests some relevance to the currently popular magnetoplasmadynamic arc. In addition to the development of suitable diagnostic devices, effort was expended on design and construction of certain peculiar operational equipment required for this program. A series of versatile, high performance capacitors suitable for low impedance pulse-forming lines are being developed in cooperation with an industrial laboratory. Likewise, a large Plexiglas vacuum tank has been built and installed to provide an optimum environment for the plasma exhaust studies. Author

N66-19539*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

PARAMETRIC EXCITATION OF TRANSVERSE WAVES IN A PLASMA

David Montgomery Feb. 1966 25 p refs *Its* Rept.-66-4 (Grant NsG-233)

(NASA-CR-71098) CFSTI: HC $1.00/MF $0.50 CSCL 20I

It is shown that an externally-imposed, oscillating electric field excites transverse electromagnetic waves propagating perpendicularly to it, in a cold plasma. The mechanism is closely related to the parametric excitation of longitudinal plasma oscillations predicted by Aliev and Silin. The problem provides an application of non-secular perturbation methods, when the equations of motion are expanded in powers of the external electric field. Arbitrarily small perturbations which arise spontaneously in the plasma are amplified by the action of the electric field, for a certain range of the driving frequency. The growth rate of the oscillations is calculated. Author

N66-19562# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.

MEGATRON ACCELERATOR Final Report, 15 Apr. 1961–15 Jun. 1964

K. C. Rogers, S. J. Lukasik, and L. Ferrari [1965] 242 p refs (Contract DA-36-039-SC-87242(E); ARPA Order 112-62) (SIT-P147(5/65); AD-622815) CFSTI: HC $6.00/MF $1.25

The Megatron (plasma betatron) Project is discussed. Construction details of the accelerator are given, and methods of shaping and measuring the magnetic guide field are described. Methods of generating the plasma and its initial properties are listed. Application of the time varying magnetic guide field results in the production of a runaway electron beam of peak energy 1 Mev and beam intensity approximately one ampere. Methods of detecting the runaway electrons are described, and the electron life histories are studied. It is found that ultimate destruction of the runaway electron beam results from a collective interaction of the beam electrons and the background plasma. The observations are compared with theoretical results of Field and Fried. Also included are the results of a computer study of early time collective effects in a cold plasma subjected to a rapidly rising betatron guide field. Author (TAB)

N66-19640*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

INTERACTIONS OF SPACECRAFT AND OTHER MOVING BODIES WITH NATURAL PLASMAS

Carol K. Sterkin, comp. Dec. 1965 198 p refs (Contract NAS7-100)

(NASA-CR-71204; JPLAI/LS-541) CFSTI: HC $5.00/MF $1.25 CSCL 20I

An annotated bibliography of 829 selected references on astronautics information resulting from a literature search and covering the period 1960 through June 1965 is presented.

It is pointed out that recent space exploration has provided data on the interactions of a moving spacecraft (satellite, rocket, or missile) with the surrounding ionized medium—ionosphere, magnetosphere, or interplanetary plasma. The practical aspects of the complex and interrelated electrical and magnetic phenomena are of primary interest. These include electrical hazards to spacecraft; effects on spacecraft communications, tracking, and detection; and effects on measurement of environmental plasma parameters. Although most of the references given concern spacecraft phenomena and related ionospheric instrumentation and data, the search also includes literature on interactions of other types of moving man-made bodies and on similar natural phenomena. The areas covered include spacecraft, aircraft, small projectiles, celestial bodies, interplanetary matter, and ionospheric research and related subjects. The bibliography also contains an author index. R.R.D.

N66-19653*# College of William and Mary, Williamsburg, Va. Plasma Physics Lab.
RADIOFREQUENCY AND MICROWAVE SPECTROSCOPY OF MAGNETIZED PLASMAS Final Report
Frederic R. Crownfield, Jr. 1 Jan. 1966 11 p refs
(Grant NsG-106-61)
(NASA-CR-71189) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Lists are given of technical reports, meeting papers, and mathematical reports which were presented during a program involving radio frequency and microwave spectroscopy of magnetized plasmas. Also given are major conclusions of the study in which very high frequency oscillation interactions with the Penning ionization gauge are emphasized. C.T.C.

N66-19682# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.
MAGNETOGASDYNAMIC HYPERCRITICAL FLOWS WITH SHOCKS Annual Summary Report
Nima Geffen May 1965 38 p refs
(Grant AF-EOAR-64-78)
(AFOSR-65-1798; TAE-41; AD-625938) CFSTI: HC $2.00/MF $0.50

Two dimensional, steady, non-dissipative magnetogasdynamic flow around given slender bodies is investigated in the hypercritical (near $A^2+M^2=1$) approximation. Similarity parameters are obtained by a simple method, and the flow over a double-wedge is formulated in the physical and in the hodograph planes. Two methods of solution are proposed, and a procedure for a digital computer given.
Author (TAB)

N66-19684# Temple Univ., Philadelphia, Pa. Research Inst.
PLASMA JET CHEMISTRY Final Report
C. S. Stokes, J. A. Cahill, J. J. Correa, and A. V. Grosse Dec. 1964 37 p ref
(Contract AF-AFOSR-62-196)
(AFOSR-65-1802; AD-625591) CFSTI: HC $2.00/MF $0.50

Three types of plasma jets are described: a noble gases plasma jet, a nitrogen plasma jet, and a plasma jet cathode as chemical feeder. Powder feeding devices and quenching devices are considered. The use of the plasma jet is described for several chemical reactions: metal oxides reduction, refractory metals nitrides formation, and refractory metals carbides formation. The temperatures attainable with plasma jets are in the range of 5000 to 50,000K. Author (TAB)

N66-19702# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIAL FLOW OF AN ELECTROCONDUCTIVE GAS IN A MOVING MAGNETIC FIELD
Ye. I. Yantovskiy 17 Nov. 1965 8 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan i Mashinostr. (Moscow), no. 2, 1961 p 114–115
(FTD-TT-65-1659/1+2+4; AD-624913) CFSTI: HC $1.00/MF $0.50

A discussion is given of one of the problems that arise in the choice of rational system of a magnetic gasdynamic machine which converts part of the energy of a high-temperature flow of gas into electric energy. TAB

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-18491# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
[CRYSTALLIZATION OF BORON AND SILICON COMPOUNDS UNDER PRESSURE, X-RAY DIFFRACTION OF CERAMIC SYSTEMS, STUDIES ON SILICA BASE GLASSES, AND RELATED STUDIES] Progress Report, Sep. 1, 1964–Sep. 1, 1965
David Turnbull Sep. 1965 7 p refs
(Contract Nonr-1866(50))
(PR-2; AD-625421) CFSTI: HC $1.00/MF $0.50

Topics include: Crystallization of B_2O_3 under pressure; Crystallization of SiO_2 under pressure; Hot stage for X-ray diffraction of ceramic systems; Melting of B_2O_3 crystals; Kinetics of devitrification of fused silica; Growth and melting of crystals of GeO_2; Structure and phase separation in thin sections of silica base glasses. TAB

N66-18503# Pennsylvania State Univ., University Park. Materials Research Lab.
PHASE EQUILIBRIUM STUDIES OF GERMANIUM AND SILICON AT HIGH PRESSURES
Carl Hobart Bates (Ph.D. Thesis) Mar. 1966 79 p refs
(Contract Nonr-656(20))
(TR-22; AD-625428) CFSTI: HC $3.00/MF $0.75

The phase relations of the high pressure polymorphic modifications of germanium were studied up to pressures of 150 kbars with the use of the oposed anvil apparatus. Long times at pressure (up to 6 weeks) favored the attainment of equilibrium and enabled the preparation of a new high pressure phase Ge-IV with the body centered cubic structure. The triple point between Ge-I (diamond structure), Ge-III (body centered tetragonal) and Ge-IV (body centered cubic) has been established at 75 kbars and 430° C. A good estimate of the triple point between Ge-I, Ge-IV and liquid is 93 kbars and 630° C. Another new phase with the simple cubic structure has been detected for the first time although its relations to the other polymorphs of germanium has not been established. Extension of this work into the Ge-Si system enabled construction of a 150° C isothermal section and a 10 mole % Si isoplethal section through the P-T-X-volume for the system. Author (TAB)

N66-18508# HP Associates, Palo Alto, Calif.
SEMICONDUCTOR MATERIALS Interim Engineering Report, 15 Jul.–15 Oct. 1965
[1965] 46 p refs
(Contract NObsr-89489)
(IER-6; AD-625676) CFSTI: HC $2.00/MF $0.50

GaAs1-xPx from a commercial source and from an in-house materials development project has been thoroughly evaluated for use in injection electroluminescence display. The work includes measurement of optical transmission, etch pit density and photoluminescence in the starting material. Processing techniques for etch polishing, Zn diffusion and diode fabrication were developed and photoluminescence of the resulting p-skins and the spectra, luminous emittance and quantum efficiency in diodes were measured. The overall conclusion is that at present only the -hpamaterial is suitable for the display application. It yields smooth regular Zn diffusion fronts; the diodes have edge emission quantum efficiencies of roughly 50 lumens/sq ft at about 10 A/sq cm. Author (TAB)

N66-18513# Delaware Univ., Newark. Dept. of Physics.
THE INSTABILITY OF NEGATIVE DIFFERENTIAL RESISTANCE
P. O. Massicot and P. L. Quinn Dec. 1965 10 p refs
(Contract Nonr-4336(00))
(TR-4; AD-625273) CFSTI: HC $1.00/MF $0.50

It is shown that the mathematical expression of the thermodynamic restriction on the power generated as a consequence of negative differential resistance in crystals given by Ridley (Proc. Phys. Soc., 82.954 (1963)) is incorrect. The appropriate relation is derived, and the influence of the formation of layer-like field domains on the possibility of stabilizing such regions is discussed. TAB

N66-18575# Whirlpool Corp., St. Joseph, Mich. Research and Engineering Labs.
THERMOELECTRIC JUNCTIONING PROJECT Progress Report, 1 Oct.–31 Dec. 1962
R. G. Sickert 31 Jan. 1963 17 p
(Contract NObs-86483)
(Rept.-3; AD-623730) CFSTI: HC $1.00/MF $0.50

Work on surface film analysis has progressed to the point where the cathodic etch process is controllable and films of 50 to 100 Å thickness can be deposited. A gold reference standard was developed; however, a superior platinum standard is now in process of evaluation. Partial identification of constituents of the sputtered films was accomplished. Melting point determination of solders was made and a near ternary eutectic solder of bismuth, antimony and tin was produced and evaluated. Examination of microstructures of solders and solder joints is in process. Studies of reaction rates between bismuth telluride, solder and copper were initiated. Diffusion layers produced in joining with the ternary eutectic solder were shown after long exposure at 450° F. Ultrasonic tinning of bismuth telluride was not successful. Author (TAB)

N66-18576# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
X-RAY EXCITATION OF FLUORESCENCE Progress Report, 1 Jul.–31 Oct. 1965
W. Low 31 Oct. 1965 6 p
(Contract N62558-4347)
(PR-2; AD-623785) CFSTI: HC $1.00/MF $0.50

New lines previously found on bombarding ruby turned out to be from atmospheric molecular nitrogen. These lines were studied in detail and the results are related to similar processes in fluorescing solids. TAB

N66-18580# General Electric Co., Schenectady, N. Y. Research Lab.
RESEARCH ON CdTe Final Report, May 1961–May 1965
R. E. Halsted, D. T. F. Marple, and B. Segall Wright-Patterson AFB, Ohio, ARL, Oct. 1965 48 p refs *Its* Rept.-65-GC-0314G
(Contract AF 33(616)-8264)
(ARL-65-205; AD-626941) CFSTI: HC $2.00/MF $0.50

The report summarizes results of the fourth year of a program of basic research on CdTe. The current status of our preparation of zone-refined single crystal material is reviewed. The results of three studies are presented; photoluminescence of defect-exciton complexes, a theoretical study of the absorption edge, and a measurement of the far-infrared refractive index and the static dielectric constant. Appended is a listing of 28 publications, 19 supported by the four-year study, and 9 facilitated by that study. Author (TAB)

N66-18612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE WIDTH OF COMBINED RESONANCE BANDS
I. I. Boyko 8 Dec. 1965 11 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 12, 1964 p 1286–1290
(FTD-TT-65-925/1+4; AD-625302) CFSTI: HC $1.00/MF $0.50

Factors due to band width of combined resonance on current carrier zones are discussed. TAB

N66-18643# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
DYNAMIC OPTICAL PROPERTIES OF LASER MATERIALS Semiannual Technical Summary Report
J. W. Carson and L. G. Komai 30 Nov. 1965 25 p refs
(Contract Nonr-4878(00); ARPA Order 306; Proj. Defender)
(AD-625894) CFSTI: HC $1.00/MF $0.50

The results of temperature profile investigations in DL quality Linde ruby using non-resonant interferometric techniques are described. This constitutes the first part of an overall study of dynamic optical distortions in laser materials. Other investigations will include gain profile studies as well as polariscopic measurements of strainbirefringence. Preliminary gain studies are presented. Author (TAB)

N66-18704# Hahn-Meitner-Institut für Kernforschung, Berlin (West Germany).
DIFFUSION OF RARE GASES IN SOLIDS Quarterly Report No. 15, Jan.–Mar. 1965
Apr. 1965 21 p refs Transl. into ENGLISH from the GERMAN Sponsored by the U.S.-EURATOM Joint Res. and Develop. Program
(Contract EURATOM-028-64-1 TEE (RD))
(EURAEC-1380; EUR-2343) CFSTI: HC $1.00/MF $0.50

Postactivation tests on UC single crystals show that their behavior is marked by an activity burst followed by only slight release; on commencement of heating or at higher temperatures, increasing release results mainly due to sample evaporation. Generally speaking, the same pattern was found for the diffusion of Ar-39 in single crystals of KCl and KBr, i.e., under 470° C at higher activation energy is observed. The following value was found for the high-temperature diffusion range: $D = 9 \times 10^{-4} \exp(-8600/RT)$ for 470–800° C. The diffusion of T in AgLi was markedly inhibited below 350° –375° C, as with the K-halides. This trend was confirmed both in isothermal tests and in experiments with continuously rising temperature. A detailed account is given of the analysis of tests involving the measurement of the gas release rate, together with a description of an apparatus for separating carrier-free Ar, Kr and Xe. Author (NSA)

N66-18705# Illinois Univ., Urbana. Dept. of Physics
LECTURES ON SPIN TEMPERATURE
Charles P. Slichter [1965] 31 p refs Presented at the Intern Symp. on Nucl. Magnetic Resonance, Osaka Univ., Japan, 7–10 Sep. 1965
(Contract AT(11-1)-1198)
(COO-1198-300) CFSTI: HC $2.00/MF $0.50

The concept of spin temperature is discussed, and used to solve problems of a complex nature. The cases of static and time-varying magnetic fields are treated. Spin-lattice relaxation and magnetic resonance are studied. The problems are approached from statistical-mechanical and thermodynamic bases. NSA

N66-18720# Illinois Univ., Urbana. Dept. of Physics.
INFLUENCE OF DISLOCATION DIPOLES ON PHYSICAL PROPERTIES
J. J. Gilman [1964] 37 p refs Presented at the Faraday Soc. Gen. Discussion on Dislocations in Solids, Gottingen, West Germany, Sep. 1964
(Contracts AT(11-1)-1198; Nonr-3985(06))
(COO-1198-222) CFSTI: HC $2.00/MF $0.50

A survey was made on the effects that edge dislocation dipoles can be expected to have on the physical properties of plastically deformed crystals. It is believed that some effects previously attributed to monopoles are more closely associated with dipoles. Various properties of dipoles are reviewed. NSA

N66-18723# California Univ., Livermore. Lawrence Radiation Lab.
THE CRYSTAL STRUCTURE OF TETRAMETHYL AMMONIUM HEXAHYDROHEXABORATE
Riley Schaeffer, Quentin Johnson, and Gordon S. Smith 19 Oct. 1964 7 p refs
(Contract W-7405-ENG-48)
(UCRL-12146) CFSTI: HC $1.00/MF $0.50

A complete X-ray structure analysis of tetramethyl ammonium hexahydrohexaborate was made. Crystals grown from water solution were examined by precision and Weissenberg methods. The structure was solved by noticing that the antifluorite structure can accommodate the octahedral $B_6H_6^{2+}$ ion at the origin and the tetrahedral (disregarding hydrogen) $N(CH_3)_4^+$ ion at $\pm 1/4, 1/4, 1/4$. Preliminary structure factor calculations verified this model. Data are tabulated. NSA

N66-18726# California Univ., Berkeley. Lawrence Radiation Lab.
GRAIN BOUNDARY ENERGY
Kurt D. Kennedy (Ph.D. Thesis) Sep. 1965 39 p refs
(Contract W-7405-ENG-48)
(UCRL-16051) CFSTI: HC $2.00/MF $0.50

The interfacial energy of [001] tilt boundaries in pure copper and copper +0.02% silver were determined by measuring the dihedral angles formed by chemical grooving in molten salt. Boundary energies were determined for three boundary orientations and nine temperatures between 200° and 1000° C. The temperature coefficient of boundary energy was similar to the temperature coefficient of the shear modulus. The boundary energy of copper at 300° C was reduced 30% by the addition of 0.02% silver but was unaffected at 1000° C. The reduction of grain boundary energy of the copper doped with silver was ascribed to silver atoms occupying sites at the boundary. The presence of silver atoms at boundary sites relieved some of the elastic strain energy of the boundary. Thermodynamic and lattice parameter data predicted segregation of silver to copper grain boundaries to approximately the same extent as indicated by reduction of grain boundary energy. Author (NSA)

N66-18729# Iowa State Univ. of Science and Technology, Ames.
STUDIES OF THE MAGNETORESISTANCE OF THALLIUM
John Crosby Milliken (M.S. Thesis) May 1965 74 p refs
(Contract W-7405-ENG-82)
(IS-T-35) CFSTI: HC $3.00/MF $0.75

The transverse magnetoresistance of thallium at 4.2 and 1° K was measured as a function of field direction and magnitude for magnetic fields up to 54 kO. The occurrence and direction of open orbits on the Fermi surface were analyzed to clarify the structure of c-axis posts and to study magnetic breakdown of the energy gap between the third and fourth Brillouin zones. The results indicated the diameter of the posts to be less than 0.091 A^{0-1}. Complete magnetic breakdown was not achieved at fields of 54 kO. For orientations where magnetic breakdown occurred, the breakdown fields decreased with an increase in the electron mean free path. Author (NSA)

N66-18730# California Univ., Berkeley. Lawrence Radiation Lab.
SUPERCONDUCTIVITY OF THE CUBIC MODIFICATION OF MoC
Louis E. Toth (Minnesota Univ., Minneapolis), Erwin Rudy (Aerojet-General Corp., Sacramento, Calif.), Jean Johnston, and Earl R. Parker Jun. 1964 17 p refs
(Contract W-7405-ENG-48)
(UCRL-11471) CFSTI: HC $1.00/MF $0.50

The superconducting transition temperatures of the metallic carbides and nitrides with the NaCl structure were interpreted on the basis of the tight-binding model of Bilz (Z. Phys. 153: 338(1958)). It was found that total valence electron concentrations from 9 to 10 are required for high critical temperatures in these compounds. The cubic modification (NaCl) of molybdenum carbide was found to be superconducting at 13.0° K in agreement with the Bilz band model. Author (NSA)

N66-18731# California Univ., Berkeley. Lawrence Radiation Lab.
PARAMAGNETIC RESONANCE OF Fe^{3+} IN POLYCRYSTALLINE FERRICHROME A
H. Hollis Wichman, Melvin P. Klein, and D. A. Shirley Sep. 1964 18 p refs
(Contract W-7405-ENG-48)
(UCRL-11685) CFSTI: HC $1.00/MF $0.50

Polycrystalline samples of iron-containing Ferrichrome A, a cyclic hexapeptide obtained from the fungus *Ustillago sphaerogena*, wee investigated by paramagnetic resonance. Spectra were obtained at several temperatures between 300° and 1° K; a prominent line of 400 Oe. width located at $g=4.3$ was observed at all temperatures, while at 1° K additional resonances at g values of 9.6, 1.3, and 1.0 were observed. The spectra were interpreted by assuming a spin Hamiltonian containing large crystal field terms compared with the Zeeman splittings; the crystal field situation is intermediate between the case of axial symmetry, with $H=D[S_z^2-1/3S(S+1)]+g\beta\ \vec{S}\cdot\vec{H}$ and a model proposed by Castner, et al (J. Chem. Phys. 32, 668 (1960)) to explain

certain iron resonances occurring at g=4.3, with $H=E(S_x^2-S_z^2)+g\beta \vec{S}\cdot\vec{H}$. Energy eigenvalues, g values, and eigenfunctions to be expected for the region between these two extremes were computed, and the results should be useful in interpreting similar spectra due to iron situated in strong crystal fields of low symmetry. Author (NSA)

N66-18738# Oak Ridge National Lab., Tenn.
THE MAGNETIC FORM FACTOR OF CHROMIUM
R. M. Moon, W. C. Koehler, and A. L. Trego (Iowa State Univ.) Oct. 1965 9 p refs Conf. on Magnetism and Magnetic Mater. held in San Francisco [1965] Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-P-1737; CONF-651106-3) CFSTI: HC $1.00/MF $0.50

Neutron diffraction measurements of the magnetic Bragg peaks from single crystals of chromium with small additions of manganese were used to determine the magnetic form factor of chromium. The addition of manganese simplifies the experimental problem by stabilizing the simple antiferromagnetic structure. A single magnetic peak was observed at reciprocal lattice positions, rather than a group of six satellite peaks as in pure chromium. Also, manganese increases the Néel point so that the measurements were performed at room temperature. The results are in good agreement with free atom Hartree-Fock calculations for the chromium 3d electrons. A definite indication of nonspherical symmetry was obtained by comparing the (221) and (300) reflections. These reflections come at the same scattering angle, yet the (221) intensity is larger by about a factor of six. This indicates a t_{2g} population of 79%, compared to 60% for a spherical spin distribution. The results are independent of manganese concentration over a range from 1.7 to 4.1 atomic percent.
Author (NSA)

N66-18790# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
PHYSICAL PROPERTIES OF UO_2 SINGLE CRYSTALS Quarterly Report No. 11, Jul. 1–Oct. 31, 1965
[1965] 16 p refs
(Contract EURATOM-056-64-3 TEEB)
(EURAEC-1320; EUR-2304) CFSTI: HC $1.00/MF $0.50

The self-diffusion coefficients for the U^{4+} ion in UO_2 were determined by analysis of the gradient in the ^{235}U concentration after diffusion anneals at 1300° and 1450° C. High temperature resistivity measurements were made on crystals in the UO_2–$UO_{2.25}$ composition range. The electrical conductivity and the Hall coefficient of a U_4O_{9-y} single crystal were determined in the temperature range from 240° to 660° K. Up to 370° K $R\sigma$ increases exponentially with temperature. The thermoelectric power of a reduced and a $UO_{2.013}$ single crystal was measured in the temperature interval 150° to 320° K. Author (NSA)

N66-18813# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Quarterly Progress Report, Period Ending Jan. 31, 1965
J. C. Appel, R. H. Chambers, and T. A. Trozera 25 Feb. 1965 28 p refs
(Contract AT(04-3)-167)
(GA-6163) CFSTI: HC $2.00/MF $0.50

Progress in a method to relate the potential-drop resistivity of tungsten single-crystals to the impurity content is reported. A relation between the ratio of the resistivities at 4.2 and 273° K and the impurities content is developed which eliminates the other factors contributing to the resistivity at low temperatures. The dislocation relaxation structures of Fe, Nb, Ta, and W are determined by applying a new method for the measurement of the mechanical-strain relaxation. This method enables the true stress-dislocation strain curve to be determined. Dislocation relaxations are separated into two components, and the contributing dislocation types are tentatively assigned. Edge and edge-screw dislocations are associated with low-temperature relaxations and screw dislocations with high-temperature relaxations. NSA

N66-18818# Los Alamos Scientific Lab., N. Mex.
RADIATION DAMAGE TO IONIC CRYSTALS AT LOW TEMPERATURES. I: X-RAY DIFFRACTION STUDIES
F. E. Pretzel and J. L. Anderson [1964] 48 p refs Submitted for Publication
(Contract W-7405-ENG-36)
(LA-DC-6725) CFSTI: HC $2.00/MF $0.50

Low-temperature X-ray diffraction was used to study lattice changes in crystallites of ionic materials resulting from low-energy β-particle bombardment at 80° K. The mechanism for radiation damage by the production of interstitial-vacancy pairs is found to apply to eleven ionic halides despite variations in structure, colorability, or ionic conduction, but the process appears to be restricted to halogen-containing crystals. Lattice expansion results show that interstitials are produced efficiently by cooperative processes at low temperature, and that most of the vacancies that are also formed do not trap electrons to become F centers. The self-trapped hole has the properties required of an intermediate in a stepwise radiation-damage process. Thermal annealing and deformation studies show that interstitial mobility is relatively high in the alkali halides. It is proposed that the interaction of mobile interstitial defects or self-trapped holes with impurities and lattice imperfections can account for many observations on the coloration of alkali halides near room temperature. Author (NSA)

N66-18901# Oak Ridge National Lab., Tenn.
DIRECT OBSERVATION OF PARTICLE REENTRAINMENT FROM SURFACES
Liliana Masironi (Ga. Inst. of Tech.) and B. R. Fish 10 Feb. 1965 13 p refs Presented at Intern. Symp. on Surface Contamination, Gatlinburg, Tenn., Jun. 1964
(Contract W-7405-ENG-26)
(ORNL-TM-1054; CONF-555-18) CFSTI: HC $1.00/MF $0.50

Particle reentrainment from various surfaces is observed and photographed microscopically in a small wind tunnel. In this apparatus, the dynamics of a moving particle in an air-stream are studied by multiple flash photomicrography. Soda-lime glass beads 28.9 μ mean diameter (±13%) on a glass surface in a turbulent flow field (Re=24,400) exhibit three main modes of response at low relative humidity: first, about half of the glass spheres do not move under repeated application of the air flow; approximately one-third of the beads leave the surface directly; finally, the remainder move slowly and intermittently along the surface until the majority of these are entrained in the air-stream over a relatively longer period of time. Author (NSA)

N66-18963# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
A PROPOSAL TO INVESTIGATE THE PHYSICAL PROPERTIES OF SAMPLES UNDER VERY HIGH PRESSURES BY TIME-OF-FLIGHT NEUTRON DIFFRACTION METHODS
R. M. Brugger Aug. 1965 20 p
(Contract AT(10-1)-205)
(IDO-17106) CFSTI: HC $1.00/MF $0.50

The possibility of investigating the properties of solids under very high pressures by neutron diffraction measurements on powdered samples was proposed and investigated. To explore the difficulties that might arise in neutron diffraction experiments on high-pressure samples, a double-axis spectrometer was assembled at the MTR and was used in measurements on Bi and KNO_3. The preliminary data showed that the resolution and intensities were superior to those for X-ray methods. Calculations indicated that a resolution improvement of X5 could be obtained over conventional diffractometers with a time-of-flight system. A simplified time-of-flight system was assembled at the MTR, and some measurements were made on Al and KNO_3. Pressure systems were proposed. NSA

N66-19147*# Linde Co., Indianapolis, Ind. Speedway Labs.
DEVELOPMENT, FABRICATION, AND DELIVERY OF NEODYMIUM DOPED YAG LASER RODS Third Quarterly Report, Sep. 18–Dec. 18, 1965
Howard M. Dess [1965] 14 p
(Contract NAS8-11865)
(NASA-CR-70873) CFSTI: HC $1.00/MF $0.50 CSCL 20L

One of the major problems initially associated with the growth of the larger size Nd:YAG crystals in the scaled-up stations was satisfactorily overcome, namely, harmful diameter fluctuations can be avoided. Several of the crystals grown were of a size adequate for the fabrication of tube-free rods 1/4 inch in diameter by 2 to 3 inches long; however, persistent cracking in the bottom regions of the crystals has thus far prevented fabrication of 1/4-inch diameter rods longer than 1.5–1.8 inches. This cracking is thought to be initiated by surface irregularities produced in approximately the lower third of the crystals as a result of bubble attachment during growth. These bubbles have thus far usually appeared only in melts from which the largest diameter crystals were growing, and only after about 2 inches of growth had occurred. Experimental work is underway to determine how to suppress the formation of the bubbles. Long-time (40 hr) annealing at 1850–1870°C caused no perceptible change in the appearance of the optical inhomogeneities associated with the tube region, both in Nd:YAG and undoped YAG rods. However, annealing a tube-free rod for only five hours at 1850°C caused an apparent improvement of some 20% in passive beam divergence. Author

N66-19151# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
AN INVESTIGATION OF THE EFFECT OF SURFACE EVAPORATION ON DIFFUSION MEASUREMENTS MADE USING THE TECHNIQUE OF ISOTOPIC EXCHANGE
D. K. Dawson, L. W. Barr, and R. A. Pitt-Pladdy Oct. 1965 21 p refs
(AERE-R-5017)

The influence of evaporation on measurements of diffusion by the heterogeneous isotopic exchange technique was examined. A standard solution for diffusion involving moving boundaries was adapted and used to analyze the results. Measurements on bromine diffusion in potassium bromide show that evaporation of the crystal influences the diffusion measurement at surprisingly low temperatures. This conclusion also seems to apply to many of the reported isotopic exchange measurements and to measurements of fission gas diffusion made by the gas release method. Based on this study a criterion is suggested to decide when the solution with evaporation should be applied. It is further shown that if there is appreciable evaporation it is not in general correct to use the method of measuring diffusion coefficients on one specimen at successive temperatures. For this procedure to be used the velocity of evaporation and the diffusion coefficient must have the same temperature dependence. Author

N66-19167*# Stanford Univ., Calif. Solid-State Electronics Lab.
LATTICE VIBRATION SPECTRA OF $GaAs_xP_{1-x}$ SINGLE CRYSTALS
Yen-sun Chen Oct. 1965 86 p refs *Its* Tech. Rept. No. 5108-1
(Grant NsG-555)
(NASA-CR-70872; SEL-65-092) CFSTI: HC $3.00/MF $0.75 CSCL 20L

Single crystals of $GaAs_xP_{1-x}$ were successfully grown in an open-tube epitaxial vapor growth system. Interactions of photons with phonons in the alloy crystals were investigated by means of reflectivity and transmission measurements in the infrared spectral region. Crystals were grown in an H_2 atmosphere on GaAs seeds, using PCl_3 $AsCl_3$ and Ge as source materials. Reflectivity spectra of $GaAs_xP_{1-x}$ were taken at 300°K in the spectral region of 220 to 500 cm^{-1}. Two Reststrahlen modes whose frequencies were close to those of TO(Γ) phonons in GaAs and GaP, respectively, were detected in the alloy. Absorption spectra in $GaAs_xP_{1-x}$ were taken at 300°K in the region of 400 to 800 cm^{-1}. A superposition of the two phonon bands characteristic of GaAs and GaP was observed in the alloy. Author

N66-19197*# Rensselaer Polytechnic Inst., Troy, N. Y.
[INTERDISCIPLINARY MATERIALS RESEARCH INCLUDING FUNDAMENTAL PHYSICS AND CHEMISTRY OF MATERIALS, ENVIRONMENTAL EFFECTS AND RELATED PROBLEMS] Semiannual Progress Report, Mar. 1–Aug. 31, 1965
Sep. 1965 26 p refs
(Grant NsG-100-60)
(NASA-CR-70371) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Brief descriptions of each project on materials research along with interim results are given. Included among the research projects are: mechanical properties of polymers, distributed second phase in dispersion-strengthened alloys, mechanisms of solidification, ultrasonic pulse interferometry, molecular structure and intermolecular action in polymer flow, high temperature and mechanical metallurgy, low temperature physics, dispersion-strengthened materials, metallic dissolution, nuclear magnetic resonance, X-ray scattering, thermal properties of polymers, vibrational spectroscopy of inorganic substances, irreversible thermodynamics of solid state polymers, thermodynamics and kinetics vaporization processes for inorganic materials, spectroscopic studies of synthetic reversible oxygen-carrying chelates, electron spin resonance, and polymer characterization. N.E.N.

N66-19366# Rensselaer Polytechnic Inst., Troy, N. Y.
GROWTH TWINNING IN PEROVSKITE-TYPE CERAMICS Final Report
Robert C. De Vries, Ernest F. Nippes, and Don B. Jugle 31 Jan. 1966 157 p refs
(Contract Nonr-591(18))
(AD-627232) CFSTI: HC $5.00/MF $1.00

Contents: structure-property relationships in itacolumite, deformation structures in $BaTiO_3$ revealed as 180 degrees domains, the control of cubic (III) twins in polycrystalline $BaTiO_3$ and their effect on the electrical properties. TAB

N66-19369# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ON THE ORIGIN OF PHASE TRANSITIONS IN VARIOUS MODELS
Gérard G. Emch Jan. 1966 20 p refs
(Contract Nonr-595(22))
(BN-433; AD-627189) CFSTI: HC $1.00/MF $0.50

A formal analogy is pointed out between the Bardeen–Cooper–Schrieffer model for superconductivity and several variations of the model suggested by Kac for the exact study of phase transitions. It is shown that similar techniques (due to Haag) can be used in all these cases, and some conclusions are drawn on the origin of both equilibrium and non-equilibrium singularities. Author (TAB)

N66-19370# Linde Co., Indianapolis, Ind. Speedway Labs.
CZOCHRALSKI RUBY Semiannual Technical Summary Report, 1 Jul.–31 Dec. 1965
Fedia R. Charvat, O. H. Nestor, and J. C. Smith 26 Jan. 1966 36 p refs
(Contract Nonr-4132(00); ARPA Order 306-62; Proj. Defender)
(SRCR-66-2; AD-627148) CFSTI: HC $2.00/MF $0.50

Overall objective of this program is to develop the Czochralski technique for the growth of large rubies of high optical quality, for laser use. Process has been scaled up to crystals 5/8 in. in diameter and 8 in. long, of similarly high quality as the smaller crystals growth previously. During high power active laser tests, internal crystal damage was observed. The damage was shown to originate at particulate scattering centers of the crucible material present in the crystal. By careful control of atmosphere above the melt, the scattering centers can be eliminated. Author (TAB)

N66-19371# Linde Co., Indianapolis, Ind. Speedway Labs.
CZOCHRALSKI GROWTH OF $LaAlO_3$ Semiannual Report, Jul. 1–Dec. 31, 1965
C. D. Brandle, H. M. Dess, and Fedia R. Charvat 31 Jan. 1966 18 p
(Contract Nonr-4793(00); ARPA Order 306; Proj. Defender)
(SRCR-66-3; AD-627149) CFSTI: HC $1.00/MF $0.50

A new growth chamber was built to provide the capacity for growing boules capable of yielding 1/4-inch diameter by 3-inch length rods of Cr^{3+} doped $LaAlO_3$. Using this growth chamber, a seed rod of the correct orientation (111) was developed. Crystals containing Ca^{2+} or Si^{4+} were also grown to confirm the belief that they are the color center producing agents. As a result of these tests, additional color center producing agents were found, La^{3+} lattice vacancies, and by proper annealing, these can be eliminated. Detwinning studies demonstrated the optimum direction to be the (111) direction of the pseudo-cube. Detwinning equipment was built which allows rods of either 1/8 or 1/4-inch diameter and up to 3-inches in length to be detwinned. Author (TAB)

N66-19420# Harry Diamond Labs., Washington, D. C.
MAGNETIC PROPERTIES OF MATERIALS IN THE SYSTEM Co_xSi_xM
David Wilcox 15 Nov. 1965 16 p refs
(HDL-TR-1311; AD-626034) CFSTI: HC $1.00/MF $0.50

Attempts to substitute Co^{2+} and Si^{4+} in the Co_xSi_xM system in a manner analogous to the isomorphous Co^{2+} and Ti^{4+} substitutions in the system Co_xTi_xM were unsuccessful. The Co^{2+} and Si^{4+} substitutions destroyed the original M-type ferrite and a W-type ferrite was formed. The appearance of materials with a cone of magnetocrystalline anisotropy and materials with a negative-anisotropy constant was attributed to the formation of a cobalt-substituted W-type hexagonal ferrite. Microphotographs and X-ray results indicated that most of the Si^{4+} was present as impure tridymite (SiO_2). Due to the difficulty of separating the mechanically bound SiO_2 from the W-ferrite grains, it was not possible to determine whether any Si^{4+} was present in the ferrite structure. Author (TAB)

N66-19469# Stanford Research Inst., Menlo Park, Calif.
EQUATON OF STATE OF SOLIDS: ALUMINUM AND TEFLON Final Report, 15 May 1964–14 Jul. 1965
G. D. Anderson, D. G. Doran, and A. L. Fahrenbruch Kirtland AFB, N. Mex., AF Weapons Lab., Dec. 1965 50 p refs
(Contract AF 29(601)-6409)
(AFWL-TR-65-147; AD-625579) CFSTI: HC $2.00/MF $0.50

Pressure, volume, and energy equation of state data obtained using shock wave techniques are presented for aluminum and Teflon. Solid aluminum samples initially at room temperature or preheated to near melting, and porous aluminum samples at room temperature, were studied over a pressure range of 200 to 1200 kbar. It was found that the largest variations of volume and energy could be achieved using porous samples. Values of Gruneisen's ratio estimated from values of the thermal pressure and thermal energy range from 2.1 to 1.37. Due to the sensitivity of Gruneisen's ratio to the Hugoniot data, it is not possible to formulate its energy or volume dependence conclusively at the present time. Of greatest significance is the fact that it does not vary widely. Solid and porous Teflon samples were studied over a pressure range of 100 to 500 kbar. Hugoniot curves drawn on the basis of the ten data points obtained indicate a variation of Gruneisen's ratio from about 0.7 to 2.0. Author (TAB)

N66-19470# Brown Univ., Providence, R. I.
PHYSICAL RESEARCH ON PROPERTIES OF II-VI COMPOUND SEMICONDUCTORS Final Report, Apr. 1962–Apr. 1965
Charles Elbaum, Arthur Lord, and Rhon Truell Wright-Patterson AFB, Ohio, ARL, Jun. 1965 52 p refs
(Contract AF 33(657)-8317)
(ARL-65-123; AD-625476) CFSTI: HC $3.00/MF $0.50

The work described in this report was concerned primarily with ultrasonic and electrical measurements made on cadmium sulphide single crystals for the purpose of studying the interaction of high frequency stress waves with charge carriers. The temperature dependence of ultrasonic attenuation, above room temperature, was found to follow the predicted dependence on the density of thermally excited charge carriers. The generation of the second harmonic of an ultrasonic wave has been studied as a function of light intensity (density of charge carriers). The amplitude of the second harmonic generally increases initially with increasing light intensity and then reaches a saturation value or broad maximum. The general behavior of the second harmonic is quite complicated and it cannot at present be fitted with any simple formalism of nonlinear phenomena in solids. Measurements of electrical resistivity as a function of position in the sample and as a function of localized illumination reveal very substantial inhomogeneity in response to light of all the specimens studied thus far. The transducing properties of cadmium sulphide have been found to depend on heat treatment through the formation of surface films which can be mechanically removed and reformed. Author (TAB)

N66-19472# Stanford Univ., Calif. Microwave Lab.
RESEARCH ON SELECTED MICROWAVE PROPERTIES OF FERRITES Final Report, 1 Apr. 1962–28 Feb. 1965
H. J. Shaw Aug. 1965 25 p refs
(Contract AF 19(628)-342)
(AFCRL-65-665; ML-1343; AD-625315) CFSTI: HC $1.00/MF $0.50

Controlled steering of a microwave acoustic beam in a ferrite was demonstrated in a YIG rod, where the direction of an acoustic beam was varied by varying the magnitude of a dc magnetic field applied at an angle to the rod axis. Analysis has been made of the frequency passband characteristics of multiple film acoustic transducers for microwave frequencies. The theory of microwave dielectric resonators without conducting walls has been developed, and experimental results on the principal circuit properties of rutile resonators have been obtained. A theory has been developed for mechanisms contributing to the excitation of phonon instabilities in ferrites. A theory has been developed for the coupling efficiency of ferrite disks as magnetostrictive acoustic transducers. Experimental investigations of nickel film magnetostrictive transducers have been performed. Measurements have been made of acoustic attenuation at room temperature in sapphire and rutile, which have disclosed that these materials offer low loss acoustic wave transmission at microwave frequencies. Theoretical and experimental investigations of second harmonic generation in ferrites have established the upper bounds on conversion efficiency for low loss ferrites. TAB

N66-19557# Stanford Research Inst., Menlo Park, Calif.
ELECTRICAL EFFECTS OF SHOCK WAVES: CONDUCTIVITY IN CsI, KI, AND NaCl Final Report
W. Murri and D. G. Doran 31 Jan. 1965 79 p refs
(Contract DA-04-200-ORD-1279)
(AD-625568) CFSTI: HC $3.00/MF $0.75

The electrical resistivities of single crystal NaCl, KI, and CsI were measured at several shock pressures in the range from 120 to 300 kbar. The resistivity of NaCl remained > 9000 omega-cm at 225 kbar. One shot in which the specimen was preheated to 480° C and shocked to 244 kbar gave an averaged resistivity of 470 omega-cm. The resistivity of KI decreased to a value between 2 and 9 omega-cm at 241 kbar; there is considerable scatter in the data below 190 kbar. Resistivity measurements on CsI were performed parallel and perpendicular to the direction of shock propagation; the resistivity decreased to 2 omega-cm at 277 kbar in the first case and to approx. 0.2 omega-cm in the latter. The data suggest a dependence of the conductivity on crystallographic direction. The data are consistent neither with electronic conduction caused by a decrease in the band gap due to shock compression of the lattice nor with ionic conduction caused by melting which may occur behind the shock front. Author (TAB)

N66-19578# Institut d'Optique Theorique et Appliquee, Paris (France).
STUDY OF OPTICAL AND TRANSPORT PROPERTIES OF THIN FILMS OF METALS AND ALLOYS Final Scientific Report
F. Abeles 9 Jul. 1965 16 p refs
(Grant AF-EOAR-48-63)
(AFOSR-65-1677; AD-624101) CFSTI: HC $1.00/MF $0.50

The results of the following investigations are presented: (1) Improvements to the preparation and fabrication of evaporated thin metallic films; (2) comparison of thin film thickness using X-rays, the temperature coefficient of the resistivity and goniophotometric measurements; (3) use of goniophotometric measurements for detecting very thin surface layers (oxides); (4) use of ellipsometric measurements for study of thin films and surfaces, with new instrumentation; (5) measurement of resistivity and Hall constant of thin metal films in vacuo with high accuracy; (6) use of the optical and electrical measurements performed on the same film in order to determine the scattering parameter and the optical effective mass of the conduction electrons, and the resistivity due to defects in the film; and (7) new results concerning the optical properties of Au, Cu, Pd, and Au-Pd. Author (TAB)

N66-19595*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CURRENT DISTRIBUTION IN A THIN FILM SUPERCONDUCTING STRIP TRANSMISSION LINE
A. R. Sass and I. D. Skurnick Washington, NASA, Mar. 1966 28 p refs
(NASA-TN-D-3344) CFSTI: HC $2.00/MF $0.50 CSCL 20L

In the long wavelength limit the current distribution in a thin film superconducting strip transmission line can be described by an inhomogeneous Fredholm integral equation of the second kind. When a fluxoid conservation derivation of this equation is considered, physical insight into the structure of the kernel follows naturally. An approximate analytic solution to the integral equation is derived for a specified range of geometrical parameters commonly encountered in practice. The solution is obtained by making use of the Liouville–Neumann method of successive approximations, and by approximating the resulting series by a series involving powers of a defined coupling factor. It is shown that the critical current of the thin film superconducting strip transmission line, based on the calculations in this report and a critical current density hypothesis, is underestimated by less than 10 percent. Author

N66-19597*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IONIC CONDUCTIVITY OF SOLID BARIUM FLUORIDE
William L. Fielder Washington, NASA, Mar. 1966 30 p refs
(NASA-TN-D-3346) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Investigations were undertaken to improve the overall accuracy of the conductivity measurements. The conductivities of four barium fluoride single crystals were determined over a wide temperature range. The energy requirements for the conductivity of barium fluoride were calculated and related to some possible mechanisms suggested for the condition. Three regions were observed: extrinsic, lower intrinsic, and upper intrinsic. In the extrinsic region, the specific conductivity of each crystal may differ. Rate equations were given for two of the crystals. All four crystals gave essentially the same conductivity for the intrinsic regions. Thermally produced defects, responsible for the conductivity of solid barium fluoride in this region, are suggested to be fluorine ion vacancies and fluorine ions in the interstitial sites. In the lower intrinsic region, migration of the fluorine ion vacancies can occur with a migration energy of about 23 kilocalories. In the upper intrinsic region, migration may become more important with a migration energy of about 26 kilocalories. H.S.W.

N66-19650*# Virginia Univ., Charlottesville. Dept. of Physics.
[THEORETICAL AND EXPERIMENTAL INVESTIGATION OF PARTICLE DETECTION AND PARTICLE DETECTORS TO IMPROVE EFFECTIVENESS, ACCURACY, AND DISCRIMINATION] Status Report No. 5, Period Ending Nov. 30, 1965
K. Ziock and R. C. Ritter [1965] 19 p refs
(Grant NsG-455)
(NASA-CR-70719) CFSTI: HC $1.00/MF $0.50 CSCL 20L

New techniques, testing, and fabrication is reported in the development of Li drifted Ge particle detectors. Relative research is detailed, results of tests are given, and problem areas are cited. Advantages over planar and five sided coaxial detectors are summarized. C.T.C.

N66-19665*# Illinois Univ., Urbana. Dept. of Physics.
AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Semiannual Status Report, Jul. 1–Dec. 31, 1965
W. Dale Compton [1965] 21 p refs
(Grant NsG-228-62)
(NASA-CR-70725) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Progress is reported in an experimental investigation of radiation effects in semiconductors. Changes in the minority carrier lifetimes of silicon resulting from irradiation with Co^{60} gamma rays were determined. The optical recombination luminescence was studied in silicon following irradiation with Co^{60} gamma rays or fast neutrons. The thermal stability of defects introduced in highly doped germanium by fast neutron irradiation was investigated. Studies were initiated to determine the properties of highly doped silicon and germanium using the tunneling of electrons between a superconductor and the semiconductor as a tool for measuring the density of states of the semiconductor. C.T.C.

N66-19671# Virginia Univ., Charlottesville. Dept. of Engineering.
FERROELECTRIC DEVICES FOR NONDESTRUCTIVE MEMORY
V. Thomas Rhyne (M.S. Thesis) Jun. 1964 87 p refs

The theory of the ferroelectric effect and a brief chronology of the discovery and application of ferroelectric materials is presented. Also, the theory of the newly discovered class of materials, the ferrielectrics, is discussed. These materials possess a threshold field and hence may be used in coincident–voltage addressing schemes. Three separate methods of nondestructive readout memory with ferroelectric and ferrielectric materials are considered: Kaufman's ceramic memory cell, Fotland's second-harmonic sensing system, and Pulvari's transpolarizer. Only the transpolarizer shows real promise as a high-speed memory element. The transpolarizer is shown to possess two stable states: the blocked state wherein it acts as a linear capacitance and the unblocked state wherein it acts as a ferroelectric capacitance with a reversible stored charge. The circuitry necessary to block and unblock the device was developed along with the driving amplifiers necessary to generate the bipolar readout voltage. A novel detection circuit was also developed and a working one-bit nondestructive readout memory was constructed. The operation of the transpolarizer is discussed and compared with the theoretical. E.E.B.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-18832# Los Alamos Scientific Lab., N. Mex.
INTERACTIONS OF DETONATION WAVES IN CONDENSED EXPLOSIVES
S. D. Gardner and Jerry Wackerle [1965] 12 p refs Presented at the 4th Symp. on Detonation, Silver Spring, Md.
(Contract W-7405-ENG-36)
(CONF-651003-6; LA-DC-6990) CFSTI: HC $1.00/MF $0.50

Flow patterns similar to regular and Mach reflection resulting from the interaction of detonation waves in condensed explosives were observed with rotating mirror cameras and flash radiography. The principal emphasis of the study was with the oblique collision of plane detonation waves. In this configuration the assumptions of steady flow, infinitesimal reaction zone thicknesses, the Chapman–Jouguet hypothesis, and simple reaction-product equations of state permit an analytic solution for the detonation parameters for regular reflection and the computation of the critical angle for the onset of Mach reflection. These critical angles were measured for Composition B, 9404-03 PBX, Baratol, and nitromethane. Additional data obtained on Composition B include a measurement of Mach stem pressure and stem shape. In inhomogeneous explosives, Mach stems and reflected shocks displayed substantial curvatures, and flash X-ray studies revealed anomalous density regions in the symmetry planes in both regular and Mach reflection experiments. These observations, along with deviations in computed and measured critical angle values, have indicated a degree of failure of the simplified theory to provide an exact, detailed description of the interaction phenomena; this failure is currently believed to result primarily from the nonuniform structure of the detonation wave. Author (NSA)

N66-18902# Los Alamos Scientific Lab., N. Mex.
EXPERIMENTAL OBSERVATIONS OF INITIATION OF NITROMETHANE BY SHOCK INTERACTIONS AT DISCONTINUITIES
J. R. Travis [1965] 24 p refs Presented at the 4th Symp. on Detonation, Silver Spring, Md.
(Contract W-7405-ENG-36)
(LA-DC-6994; CONF-651003-5) CFSTI: HC $1.00/MF $0.50

Shock interactions at density discontinuities introduced into nitromethane compressed by a plane shock wave can reduce the induction time for initiation of detonation near the discontinuity. Experimental results are presented which illustrate this phenomenon and which corroborate the theoretical results presented by Mader in his paper in this symposium. The initiating efficacy of a discontinuity formed by a solid inclusion immersed in nitromethane is strongly dependent on the material used. It is also dependent on the dimensions of the object in the directions parallel and perpendicular to the front of the initiating shock when these dimensions are between a lower critical size and an upper effectively infinite size, and on the angle of incidence between the shock and the discontinuity. Data which relate the induction time to these parameters are presented. Author (NSA)

N66-19253# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTICS OF MICROCONTAMINATIONS IN AVERAGE DISTILLATE FUELS
Ya. B. Chertkov, V. N. Zrelov et al 17 Nov. 1965 16 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 10, 1962 p 56–59
(FTD-TT-65-1020/1+2+4; AD-625149) CFSTI: HC $1.00/MF $0.50

Microcontaminations in fuels are formed as a result of the physico-chemical reaction of compounds with ashy elements, high-molecular tarry compounds and moisture. Compounds with ashy elements fall into the fuel as a result of corrosion of the apparatus and transportation media, wear of friction component mechanisms, the carrying in of dust from the air, and the washing out of certain fillers of plastic materials. Formation of much larger contamination particles takes place basically on account of enlargement of small particles characteristic of high dispersion systems. Under the effect of temperature, of mixing, of excessive pressure and other factors, formation of particles with the dimension of 0.1 to 1 microns and their further packing increases sharply. To prevent or limit fuel contamination and to permit proper exploitation of fuel economy, it is advisable to make systematic removal of moisture from the fuel, and to prevent the formation of high molecular tar particles and penetration into the fuel of compounds with 'ashy' elements. Author (TAB)

N66-19378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABRASIVE PROPERTIES OF MICROCONTAMINATION AND OXIDATION PRODUCTS OF JET FUELS

V. A. Piskunov and V. N. Zrelov 13 Jan. 1966 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 5, 1965 p 49–52
(FTD-TT-65-1448/1+4; AD-626963) CFSTI: HC $1.00/MF $0.50

Conclusions: Microcontaminants and residues from thermo-oxidation origin in fuel are the cause of abrasive wear of the hydraulic channels and jet nozzles of the fuel-regulating apparatus of jet engines. The extent of the abrasive wear of the fuel-regulating apparatus of the engines depends on the amount and make-up of the microcontaminants and residues in the fuel determinable by the conditions of the transportation, storage, and application of the fuels and their thermal stability. For lowering the abrasive action of the microcontaminants and residues, it is necessary to increase the fineness of the filtration and improve the thermal stability of the fuels (additives, etc.). Author (TAB)

N66-19430# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF IMPROVING THE THERMO-OXIDATION STABILITY OF HYDROCARBON FUELS

F. Yu. Rachinskiy, Yu. A. Bruk, and G. F. Bol'shakov 8 Dec. 1965 6 p Transl. into ENGLISH from Russian Patent no. 159591 (Appl. no. 805093/23-4, 29 Nov. 1962) 2 p
(FTD-TT-1127/1+4; AD-625247) CFSTI: HC $1.00/MF $0.50

The object of the invention is a method of improving the thermooxidation stability of hydrocarbon fuels by means of the addition of other substances which has the distinguishing feature that, for the additives, there were used derivatives of mercaptan. Author (TAB)

N66-19457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REACTION CHARACTERISTICS OF SPILLS OF FLUORINE AND FLUORINE–OXYGEN MIXTURES UPON VARIOUS MATERIALS

Louis M. Russell, Harold W. Schmidt, and Robert F. Clarke Washington, NASA, Mar. 1966 23 p refs Film Supplement No. C-243 to this report is available on loan from Lewis Research Center
(NASA-TN-D-3118) CFSTI: HC $0.25/MF $0.50 CSCL 21I

Small quantities of liquid fluorine, liquid oxygen, and liquid 30-percent FLOX were spilled upon various common materials which might be found or placed around a rocket test or launch facility for the purpose of investigating hypergolicity and other reaction characteristics. When fluorine or 30-percent FLOX is spilled upon many of these common materials, sufficient hypergolic reaction can occur to create a combustive hot spill. The hot spill creates a rapid high cloud rise, which provides efficient diffusion and dispersion of the toxic products and tends to reduce the potential downwind ground-level pollution. The reactions varied from smooth-burning reactions to strong detonations; the variation depended upon whether FLOX or fluorine was spilled and upon which materials they were spilled. Spills of liquid fluorine or FLOX upon materials with which they do not react combustively resulted in typical cryogenic cold spills in which the toxic vapors drifted downwind close to the ground and thus created high pollutant concentration for a considerable distance downwind. The desirable characteristics of the FLOX-charcoal reaction indicate that the placement of charcoal in areas of possible fluorine or FLOX spills could provide effective spill and pollution control. Author

N66-19560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ADDITIVE TO SULFUROUS FUEL

M. I. Shapovalov 8 Dec. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 157034 (Appl. no. 755907/23-5, 15 Dec. 1961) 2 p
(FTD-TT-65-1126/1+4; AD-625248) CFSTI: HC $1.00/MF $0.50

The object of the invention is an additive to sulfurous fuel on the basis of tricresylphosphate and nitrobenzene which has the distinguishing feature that, for the purpose of reducing the wear on the piston cylinders and lessening the scale formation, there are introduced isopropyl spirits and chromium nitrate. Author (TAB)

N66-19561# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ADDITIVE TO SULFUROUS FUELS FOR HIGH-SPEED DIESEL ENGINES

N. A. Butkov, P. A. Sukhorukov, Ye. A. Kazmina, P. P. Botkin, and V. S. Yamburenko 8 Dec. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 155359 (Appl. no. 783879/24-6, 22 Jun. 1962) 2 p
(FTD-TT-65-1125/1+4; AD-625246) CFSTI: HC $1.00/MF $0.50

The object of the invention is an additive to sulfurous fuels for high-speed Diesel engines, which has the distinguished feature that, for the purpose of lowering the scale formation and wear of the engines, as an additional active component barium naphthenate is introduced in the amount of 0.6% with a corresponding lowering in the content of deparaffined heavy gas oil from 91% to 90.4%. TAB

N66-19627*# Brown Univ., Providence, R. I. Div. of Engineering.

PARTICLE SIZE OF ALUMINUM OXIDE PRODUCED BY A SMALL ROCKET MOTOR

R. A. Dobbins Nov. 1964 39 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950573)
(NASA-CR-71208) CFSTI: HC $2.00/MF $0.50 CSCL 21I

A spectrophotometric technique has been devised that allows measurements in situ of a well defined mean size of particles which are below the limits of optical resolution and

which may be moving at unknown velocities of 6000 ft./sec. or more. The particle size of aluminum oxide produced by a solid propellant was measured by spectrophotometric observations on the near plume of a small rocket. The tests indicate that mean particle size, i.e., the ratio of third to second moment of the size distribution function, is 0.4 to 0.6 microns, is independent of chamber pressure in the rocket motor and is only weakly dependent on the residence time of the products within the combustion chamber. These results are in disagreement with tests conducted with the same rocket motor and propellant in which all products of combustion were collected in an evacuated receiver tank. Further tests are described that are designed to resolve the present contradiction. The spectrophotometric method has potential application to the measurement of particle size of Al_2O_3 produced by rocket motors that are too large to be tested by the tank collection technique. Author

N66-19647*# Boeing Co., Seattle, Wash. Aero-Space Div.
INVESTIGATION OF THE FEASIBILITY OF FLOX FOR PERFORMANCE IMPROVEMENT ON THE S-IC
M. E. Schlapbach 31 Dec. 1964 293 p refs
(Contract NAS8-5608)
(NASA-CR-70720; D5-11464-1; TAO-22) CFSTI: HC $6.00/MF $1.50 CSCL 21I

The payload of the Saturn V vehicle can be increased up to 65 percent by using 70 percent Liquid Fluorine and 30 percent Liquid Oxygen (FLOX) as the oxidizer on the S-IC. This would require moderate changes to the engine and stage. By using essentially the existing engines and the stage, the payload can be increased approximately 38 percent. Implementation of FLOX on the S-IC will require minor stage material changes and redesign of some items to minimize contaminant traps since fluorine reacts with most contaminants. A passivation procedure may be used to minimize contaminant reaction. Toxic exhaust cloud problems exist; however, investigation indicates general feasibility. A fairly sophisticated launch or test area weather sampling network fed into an appropriate computer system for continuous cloud behavior predictions would probably be required before large scale use of FLOX on the S-IC could be implemented. Launch time restrictions can be expected under certain weather conditions. Storing and handling of FLOX would require modifications and additions to the ground support equipment. Author

N66-19672# Library of Congress, Washington, D. C. Aerospace Technology Div.
LIQUID AND SOLID PROPELLANTS TECHNOLOGY Surveys of Communist World Scientific and Technical Literature
Edward Wolski 7 Jan. 1966 160 p refs Compilation of abstracts
(ATD-66-2)

Abstracts from the Soviet literature on liquid propellants, solid propellants, high energy fuels, advanced energy sources, and combustion are presented. A total of 214 entries from 53 journals and 15 books are annotated. E.E.B.

N66-19699# Rocketdyne, Canoga Park, Calif.
RESPONSE OF A BURNING SOLID PROPELLANT TO PRESSURE WAVES OF FINITE AMPLITUDE
A. L. Huebner and T. A. Coultas Jun. 1965 79 p refs
(Contract AF 49(638)-1208)
(R-6213; AFOSR-65-1733; AD-624944) CFSTI: HC $3.00/MF $0.75

Shock-tube techniques were utilized to determine the response of a burning solid propellant surface to pressure perturbations of small, but finite amplitudes. This method of obtaining propellant responses is described with emphasis upon the techniques which were developed to remove undesirable temperature gradients. Other experimental techniques utilized to obtain high-frequency response pressure measurements under reproducible pressure, flow, and temperature conditions are described. The propellants include those (both aluminized and nonaluminized) with a wide range of pressure exponents as well as absolute burning rate. All of these experiments were conducted at about 400 psia ambient pressure. A discussion of the treatment of the experimental data to obtain Fourier transforms and the propellant response as a function of frequency is presented, with particular emphasis upon the significance and reproducibility of the data. Author (TAB)

N66-19750# Air Force Systems Command, Wright-Patterson AFB, Ohio.
INSOLUBLE RESIDUES, FORMING DURING THE HEATING OF JET FUELS
G. F. Bol'shakov 3 Dec. 1965 8 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 5, 1963 p 55–57
(FTD-TT-65-1064/1+2+4; AD-625143) CFSTI: HC $1.00/MF $0.50

The purpose of the work was to investigate the composition of insoluble residues, forming during the heating of jet fuels in contact with metals. The following fuels were studied: No. 1 TS-1 fuel, hydrogenated, with a total sulfur content of 0.011%; No. 2-TS-1 fuel, commercial, with total sulfur content of 0.16%, mercaptan content 0.007%; 3-TS-1 fuel, commercial, with total sulfur content of 0.065%, mercaptan content 0.003%. Copper alloys (bronze and brass) accelerate the autooxidation processes of fuels, promoting the formation of deposits on the metal, and increase the corrosion activity of the fuels. Duralumin D1T and especially steel 12KHN3A produce a much lesser effect on heated fuel, than bronze and brass. Metals not only catlytically accelerate residue formation, but they themselves actively participate in these processes. Removal of ashes and other elements from the fuel composition would lead to a slowing down of residue formation processes in fuels. TAB

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

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N66-18552# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF SELECTING OPTIMUM PARAMETERS OF A DOUBLE CASCADE GAS TURBINE ENGINE
A. M. Topunov and B. A. Tikhomirov 8 Dec. 1965 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 3, 1965 p 108–118
(FTD-TT-65-1656/1+2+4; AD-625244) CFSTI: HC $1.00/MF $0.50

Equations are obtained to evaluate the effect of determining parameters of cycle and stage on the strength working conditions and radial blading dimensions of blading turbines of two cascade gas turbine engines (GID). Results are given of calculations showing the intensity of the effect of determining parameters on strength working conditions and radial blading dimensions of turbo compressors (TVD). Basic laws are revealed of TVD stage parameter relationship and parameters of the cycle of a double cascade GTD at constancy conditions of the maximum of long lasting strength of blades. Also discussed is the evaluated intensity of the effect of determinant cycle parameters and TVD on the economy of a two stage (two cascade) GTD at reserve constancy condition with respect to the maximum of long lasting strength of the blades. TAB

N66-18557# Continental Aviation and Engineering Corp., Detroit, Mich.
HEAVY-LIFT TIP TURBOJET ROTOR SYSTEM. VOLUME XIII: PRELIMINARY MODEL SPECIFICATION FOR CONTINENTAL MODEL 357-1 ENGINE
Oct. 1965 53 p Prepared for Hiller Aircraft Co.
(Contract DA-44-177-AMC-25(T))
(USAAVLABS-TR-64-68M; AD-625823) CFSTI: HC $3.00/MF $0.50

The report contains Continental Preliminary Model Specification No. 2253-A, which contains requirement, capability, and engine performance data on the Continental Model 357-1 (1700-pound thrust) turbojet engine for helicopter rotor-tip mounting. Author (TAB)

N66-19106 Florida Univ., Gainesville.
BASIC ROCKET PROPULSION
David T. Williams *In its* Nucl. Rocket Propulsion 1964 p 32–57 (See N66-19106 09-22)

The nature and function of the propulsion process necessary for changing the orbit of a spacecraft are discussed. The basic concepts of propulsion are reviewed, and the importance of determining the mass of fuel expended in a given maneuver is stressed. Formulas are given for finding the mass ratio, and it is pointed out that the cost in fuel of any desired changes in orbit can be computed, given the specific impulse of the rocket. Requirements for the take-off maneuver are defined, and equations are given for describing the lift-off from an airless earth, and ascent from the air-covered earth. Structural weight considerations for a rocket tank containing fuel are examined, and the items of dead weight in the rocket vehicle that limit the possible mass ratio of a stage are listed. Procedures are also outlined for finding the optimum distribution of staging. An illustrative computation relating to an interplanetary mission is included. M.G.J.

N66-19172*# Atlantic Research Corp., Alexandria, Va.
STUDY OF PROPELLANT VALVE LEAKAGE IN A VACUUM Phase IV Report, 10 Dec. 1965–14 Jan. 1966
Ralph D. Gift, John A. Simmons, Joseph P. Copeland, Jack M. Spurlock, and Jaydee W. Miller 17 Feb. 1966 84 p refs
(Contract NAS9-4494)
(NASA-CR-65237) CFSTI: HC $3.00/MF $0.75 CSCL 21H

Adverse effects of evaporative freezing of propellant in the manifolds of the Gemini 25-pound and 100-pound orbit attitude maneuvering system (OAMS) rocket engines are described. The investigation consisted of a theoretical analysis of evaporative freezing of propellant in the injector manifolds of the OAMS engines, and an experimental study of flow stoppages caused by such freezing. Preliminary data show: (1) Leading nitrogen tetroxide can freeze evaporatively and obstruct flow in the oxidizer manifolds, but monomethylhydrazine cannot. (2) The residual propellant in the manifold after engine shutdown does not obstruct subsequent propellant flow. (3) Obstructions created by evaporatively frozen nitrogen tetroxide caused either a delay in the initiation of flow and/or a delay in achieving full flow after the valve was opened. It was decided that sufficient data are not available to establish conclusively the seriousness of the freezing effect on the Gemini spacecraft performance. N.E.N.

N66-19173# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
HYPERSONIC PROPULSION LABORATORY. ANNUAL REPORT, NOVEMBER 1964–OCTOBER 1965
Oct. 1965 75 p refs
(Grant DRB-G-9550-06)
(Memo-65-2) CFSTI: HC $3.00/MF $0.75

Summaries are presented on 17 research projects concerned with hypersonic air breathing engines, and test facilities and instrumentation development. Areas covered include gun-launched scramjet trajectory calculations; lifting configurations for high supersonic speeds; shock reflection and interaction at hypersonic speeds; extension of turbulent incompressible boundary layer theory to compressible boundary layers; incompressible turbulent boundary layer development in an arbitrary pressure gradient; secondary fluid injection into a supersonic airstream; turbulent flow combustion; cooled, thin film anemometer development; supersonic combustion experiments; nonequilibrium supersonic nozzle flows; solutions for turbulent free mixing of compressible reacting gases; turbulent free jet mixing flow with dissociation–recombination reaction; optical method for correlating turbulent coaxial jet flow; and high temperature pyrometry and instrument calibration. A study was initiated on aerodynamic surface performance derived from axisymmetric flow fields, and modifications to the zirconia pebble-bed heated wind tunnel are reported. N.E.N.

N66-19239# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLOSED-CYCLE GAS-TURBINE INSTALLATION
I. M. Kovtun, A. N. Naumov, and S. L. Kosmatov 30 Nov. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 166202 (Appl. no. 824084/24-6, 9 Mar. 1963) 2 p
(FTD-TT-65-1141/1+2+4; AD-625001) CFSTI: HC $1.00/MF $0.50

The use of inverse chemical reactions which are accompanied by heat is proposed for the gaseous mixtures in closed-cycle gas-turbines. Also, the thermodynamics of such systems is examined. N.E.N.

N66-19400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOW FREQUENCY INSTABILITY OF THE NOMINAL REGIME OF A LIQUID ROCKET ENGINE
K. S. Kolesnikov 14 Dec. 1965 33 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 2, 1965 p 119–130
(FTD-TT-65-1772/1+2+4; AD-625298) CFSTI: HC $2.00/MF $0.50

Several mechanisms describing unstable combustion in the liquid rocket engine chamber (ZHRD) are discussed. One of the mechanisms is based on the fact that the rate of fuel injection into the chamber with respect to the pressure drop on the sprayers has a lagging of the relaxation time order of the fuel feeding time, and the combustion follows the rate of in-

jection with a delay, equal to the conversion time. The oscillatory semiperiod is approximately equal to the time of conversion and time of the relaxation system. Presented are dynamic schemes giving the possibility for solving various problems: to investigate the effect of parameters and their combinations on the stability of the rated regime of the system; to mark such ratios of parameters, that the system would be stable; to select means and stabilization methods (including the use of automatic devices to control the fuel feed into the chamber) and formulate requirements to same; to determine permissible change areas of certain parameters, taking into consideration the values of remaining parameters; and finally to take into account fuel injection oscillations during the study of high frequency vibrations in the chamber. M.R.W.

N66-19426# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
BASIC STUDIES OF ROTATING STALL AND AN INVESTIGATION OF FLOW-INSTABILITY SENSING DEVICES. PART I: BASIC STUDIES OF ROTATING STALL FLOW MECHANISMS Final Report, Feb. 1964–Oct. 1965
W. G. Brady and G. R. Ludwig Wright-Paterson AFB, Ohio. AF Aero Propulsion Lab., Oct. 1965 103 p refs
(Contract AF 33(615)-1240)
(CAL-DF-1901-S-7; AFAPL-TR-65-115, Pt. I; AD-625783) CFSTI: HC $4.00/MF $0.75

The report describes an experimental and analytical investigation of flow processes basic to the problem of rotating stall in axial flow compressors. Boundary-layer studies show that simple analytical treatment of flow separation on a wall moving upstream is not feasible, whereas, partial analytical success was obtained for flow separation on a wall moving down-stream. A stability theory for small disturbances propagating rotationally in the mean swirled flow through a thin annulus with multiple actuators (blade rows) was derived. Comparisons with experimental rotating stall data show fair-to-good agreement of propagation velocities but inaccurate predictions of inception of instability. Additional research is proposed related to lift hysteresis on airfoils in separated flows, time-delay inherent in the leading-edge separation process, and modification and extension of the developed stability theory. Author (TAB)

N66-19471# Thiokol Chemical Corp., Elkton, Md.
PULSE TESTING OF AN APACHE AND CAJUN SOLID ROCKET MOTOR FOR RESONANCE Scientific Report No. 1, Feb.–Oct. 1965
John W. Edwards and John Mallick 30 Nov. 1965 14 p
(Contract AF 19(628)-4068)
(E107-65; AFCRL-65-895; AD-625775) CFSTI: HC $1.00/MF $0.50

The possibility of inducing combustion instability in the Apache and Cajun solid propellant rocket motors was investigated by introducing an acoustic disturbance; pulse tubes loaded with black powder were fired. One Apache and one Cajun rocket motor were tested. The reduced data show that the acoustic disturbances introduced into the motors by the firing of the pulse tubes rapidly dampened out. Since the scope of the testing was limited, it is not possible to conclude absolutely that the Apache or Cajun will never resonate; however, the probability of resonance is very slight. Author (TAB)

N66-19478*# Hughes Research Labs., Malibu, Calif.
ION ROCKET ENGINE DEVELOPMENT Quarterly Report No. 3, 1 Apr.–30 Jun. 1965
S. A. Thompson, H. L. Garvin, W. E. Mc Kee, D. E. Zuccaro, and A. J. Couvillion 30 Dec. 1965 119 p
(Contract NAS3-6271)
(NASA-CR-71066) CFSTI: HC $4.00/MF $0.75 CSCL 21C

A series of three four-strip integral focus ion engines, using a tungsten ionizer, was evaluated. The third engine was tested for 954 hours, until the cesium supply was expended. The drains were less than 1%, and the apparent neutral fraction was 0.6% during the test. A cesium contact ion engine with a lifetime far greater than that attainable with a tungsten surface appears feasible. Measurements of neutral fraction from both rhenium and iridium coated surfaces show that the neutral fraction can be reduced by 1/20 to 1/50 the value for tungsten. Engine life would increase by the same factor. The effect of neutral fraction on electrode life is shown graphically. For this class of engine (nonporous focus tip), erosion from focus tip originated ions is negligible compared with electrode erosion resulting from charge exchange ions. A summary of the tungsten was well as rhenium and iridium data is also presented. An engine life greater than 30,000 hours at a current density of 20 mA/cm^2 appears to be attainable with the high work function surface. Author

N66-19507*# Naval Ordnance Test Station, China Lake, Calif.
ACOUSTIC LOSSES OF A SUBSCALE, COLD-FLOW ROCKET MOTOR FOR VARIOUS "J" VALUES
F. G. Buffum, G. L. Dehority, R. O. Slates, and E. W. Price Feb. 1966 82 p refs
(NASA Order WO-3034)
(NASA-CR-71086; NAVWEPS-8971; NOTS-TP-3932) CFSTI: HC $3.00/MF $0.75 CSCL 21H

Acoustic dissipation studies were undertaken using a subscale, cold-flow rocket motor model to determine the effect of purely geometric variables on the acoustic performance leading to axial mode combustion instability. Cold air served as the working fluid to simulate the internal flow and to obtain a critical nozzle throat condition. Using interchangeable metal parts, it was possible to simulate the geometry of a cylindrical-bore grain at various real motor burn times and also to vary the nozzle throat diameter. The results confirmed the speculation that, for practical motor designs, the radiation of acoustic energy through the nozzle is the largest source of loss for the axial mode and increases with the J of the motor. In view of the change in J with time during burning, this loss can vary conspicuously during the motor burn time. Author

N66-19521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURVEY OF ELECTROMAGNETIC ACCELERATORS FOR SPACE PROPULSION
Stanley Domitz, H. G. Kosmahl, Peter Ramins, and N. John Stevens Washington, NASA, Mar. 1966 127 p refs
(NASA-TN-D-3332) CFSTI: HC $4.00/MF $1.00 CSCL 21C

A survey of the experimental status of electromagnetic or plasma accelerators is presented. This survey is limited to the major programs of recent years on plasma accelerators for spacecraft propulsion and does not cover the purely research activities in plasma physics. At present plasma accelerators are at the stage of demonstrating feasibility, collecting performance data, and investigating the problems of operation. A broad approach covering a wide range of input power requirements and types of accelerators is being pursued. There is, however, a definite tendency towards devices using coaxial geometry, minimum electrode areas, and short interaction lengths. Author

N66-19577# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
THICKNESS SHEAR VIBRATIONS OF AN ABLATING ROCKET
J. D. Achenbach Jul. 1965 21 p refs
(Contract Nonr-1228(34))
(TR-65-3; AD-624737) CFSTI: HC $1.00/MF $0.50

This paper presents an analytical study of the axial shear vibrations of a long hollow cylinder that is subjected to time dependent body forces in the axial direction. The outer surface of the cylinder is bonded to a rigid case, and the inner radius increases monotonically with time. An expression is determined for the shear stress at the bond-interface. It is shown that the frequency of the shear-bond stress increases, and that its amplitude decreases towards burnout time. The shear stress is studied for various ablation rates. Conventional methods of analysis, such as separation of variables and Fourier-Bessel analysis, are not directly applicable in this problem, since the boundary conditions are prescribed on a time dependent surface. A modified Fourier-Bessel mode is defined that satisfies the boundary conditions. By substituting this mode into the equation of motion, a solution is obtained by asymptotic methods in the vicinity of the bond-interface. The analysis is extended to include the axial shear vibrations of an ablating viscoelastic cylinder. Viscoelasticity is introduced by means of the relaxation function in shear.

Author (TAB)

N66-19590*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TURBULENCE, HEAT-TRANSFER, AND BOUNDARY LAYER MEASUREMENTS IN A CONICAL NOZZLE WITH A CONTROLLED INLET VELOCITY PROFILE

Donald R. Boldman, James F. Schmidt, and Anthony Fortini Washington, NASA, Mar. 1966 28 p refs

(NASA-TN-D-3221) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Turbulence, heat-transfer, and boundary layer measurements were obtained in a conical nozzle operating in air at a nominal total temperature and pressure of 960°R and 300 psia, respectively. Experimental heat-transfer coefficients were compared to values determined by three prediction techniques; namely, (1) Nusselt number correlation, (2) a compressible boundary layer theory, and (3) an incompressible boundary layer theory. Methods (1) and (2) yielded nozzle heat-transfer coefficients that were appreciably higher than experimental values; however, method (3) predicted the nozzle heat-transfer coefficients very well yielding results that were within about 2 percent of the experimental values at the throat. In part of the investigation a simulated nuclear reactor core turbulence generator installed 3 inches upstream of the cylindrical inlet failed to alter the nozzle heat-transfer coefficients. In addition, the turbulence generator had essentially no effect on the boundary layer temperature profiles in the nozzle.

Author

N66-19603*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COLD-AIR PERFORMANCE EVALUATION OF SCALE MODEL OXIDIZER PUMP-DRIVE TURBINE FOR THE M-1 HYDROGEN-OXYGEN ROCKET ENGINE. II: OVERALL TWO-STAGE PERFORMANCE

Richard J. Roelke, Roy G. Stabe, and David G. Evans Washington, NASA, Mar. 1966 34 p refs

(NASA-TN-D-3368) CFSTI: HC $2.00/MF $0.50 CSCL 21H

At equivalent design speed and pressure ratio, the turbine static efficiency was 0.524 and the equivalent specific work was 9.61 Btu per pound compared with the design values of 0.536 and 9.832 Btu per pound, respectively. The turbine equivalent weight flow was 10.8 percent less than design. Of this deficit, 3.7 percent was attributed to an undersize nozzle throat area of the test hardware, and the remaining part was charged to adverse flow conditions in the inlet manifold and nozzle channels. The result of these deviations from design was a net loss of 12.8 percent in turbine power at design speed and pressure ratio. Radial surveys taken at the turbine exit at design equivalent speed and pressure ratio revealed circumferential and radial variations in total pressure similar in pattern but attenuated from those measured in prior inlet manifold surveys. Also observed was overturning of the flow and large circumferential variations in absolute flow angle, both of which occurred at all but the tip region of the blade passage. In the tip region, flow velocities lower than design existed, which lead to significant underturning of the flow. Static-pressure measurements taken on each side of the rotor disks below the hub indicated shaft thrusts considerably higher than anticipated.

Author

N65-19626*# Hughes Aircraft Co., El Segundo. Calif. Space Systems Div.

SOLAR POWERED ELECTRIC PROPULSION SPACECRAFT STUDY Final Report

Dec. 1965 470 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951144)

(NASA-CR-71185; SSD-50094R) CFSTI: HC $7.70/MF $2.25 CSCL 21C

The feasibility of achieving significant improvement in mission capability for unmanned planetary exploration spacecraft by using advanced solar photovoltaic power systems in conjunction with electric propulsion thrustor systems is discussed. The study is augmented by a hardware verification program which involves the design and development of power conditioning, feed and control systems; and culminates with a 500-hour life and performance test of a complete electric propulsion system using a bombardment ion thrustor. It is indicated that if electric propulsion was to be useful as a tool in early space exploration, the special problems associated with the use of a solar power source needed to be evaluated. The fact that the power level varies with the distance from the sun is a major contributor to these problems. The mission capability of a solar powered electrically propelled spacecraft was compared with all-chemical systems. It is reported that the results have been extremely encouraging.

R.R.D.

N66-19692*# General Dynamics/Convair, San Diego, Calif.

PRELIMINARY DESIGN OF A FLOX DISCONNECT FOR A FLOX-ATLAS VEHICLE Final Report

L. E. Siden, A. P. Traskell, and R. H. Anderson 13 Sep. 1965 158 p refs

(Contract NAS3-3245)

(NASA-CR-54877; GD/C-BHV65-004) CFSTI: HC $5.00/MF $1.00 CSCL 21H

This report presents the results of a study program to establish a preliminary design of a multiple purpose disconnect for use in a FLOX-Atlas oxidizer system. Design requirements are defined, current technology is reviewed, and a selected valve design is presented and installed in three locations.

Author

N66-19734*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A LOW-PRESSURE-LOSS SHORT AFTERBURNER FOR SEA-LEVEL THRUST AUGMENTATION

Carl C. Ciepluch, Wallace W. Velie, and Richard R. Burley Washington, NASA, 7 Jun. 1955 31 p refs

(NACA-RM-E55D26) CFSTI: HC $2.00/MF $0.50 CSCL 21E (Declassified)

An investigation of the problems associated with the design of a low-pressure-loss, short afterburner for sea-level thrust augmentation was conducted in a static, sea-level test stand using the power section of a 5970-pound-thrust, axial-flow turbojet engine. An 11 1/2° innerbody diffuser with tur-

bine-discharge flow-straightening vanes installed had the lowest pressure loss of any of the diffusers investigated. The tail-pipe pressure loss was reduced 1 percentage point by fairing (flattening) the afterburner fuel-spray bars, which were located in the high Mach number, turbine-discharge flow. The total-pressure loss of a 28-spray-bar, short-afterburner configuration was 5.5 percent of the turbine-discharge pressure, which was approximately equal to the loss of the standard engine tail pipe. The 28-spray-bar, short-afterburner configuration had a peak combustion efficiency of 0.95 at an over-all fuel-air ratio of 0.045. Maximum thrust augmentation of 1.44 was obtained with this short afterburner. Author

N66-19763*# TRW Systems, Redondo Beach, Calif. Physical Electronics Lab.

PROGRAM OF LARGE HIGH PERVEANCE IONIZER STUDIES

J. C. Beynon, S. G. Forbes, and P. W. Kidd 15 Sep. 1965 103 p refs

(Contract NAS3-5906)

(NASA-CR-54326; TRW-4175-6013-SU-000) CFSTI: HC $4.00/MF $0.75 CSCL 21C

A description is given of a study conducted on large porous tungsten sources of cesium ions, with emphasis being placed on ionizer performance at high current densities. Also emphasized is the relation of ionizer performance to physical properties such as density, pore size and uniformity, and transmissivity. Details are given of fabrication, testing, and measurement procedures, and a detailed discussion is included of problems in obtaining results with large ionizers comparable with those of smaller samples. C.T.C.

N66-19777# Sheffield Univ. (England). Dept. of Fuel Technology and Chemical Engineering.

INTENTIONAL COMBUSTION OSCILLATIONS IN PROPULSION SYSTEMS Final Scientific Report

D. Harris and J. Swithenbank 25 Jan. 1965 24 p refs

(Grant AF-EOAR-63-101)

(HIC-54; AFOSR-65-1804; AD-625499) CFSTI: HC $1.00/MF $0.50

Magnetohydrodynamic (MHD) power generation has been shown theoretically to be attractive when the amplitude of oscillation is 50% or greater. The mean conductivity is increased by approximately one and a half times. To substantiate this theoretical analysis an experimental rig was designed and constructed. This comprises of a gaseous (Hydrogen-Air) rocket motor where the air is introduced tangentially and the fuel is introduced either longitudinally or tangentially. Combustion oscillations were produced. TAB

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-18631# Library of Congress, Washington, D. C. Aerospace Information Div.

PROBLEMS OF SPACE MAGNETISM, VAN ALLEN RADIATION BELTS, PLASMA IN SPACE, AND AURORAS Review Article of Soviet Publications

Mar. 1964 24 p refs

(AID-U-64-17; AD-623240) CFSTI: HC $1.00/MF $0.50

A review is given of Soviet publications concerned with the following topics: space magnetism measured from rockets and satellites, the Van Allen radiation belts, plasma in space, and auroras. TAB

N66-18850 Los Alamos Scientific Lab., N. Mex.

VELA SATELLITE MEASUREMENTS

James H. Coon 1965 47 p refs Presented at Conf. on Radiation Trapped in the Earth's Magnetic Field, Bergen

(Contract W-7405-ENG-36)

(LA-DC-7365; CONF-650816-2) CFSTI: HC $2.00/MF $0.50

The Vela satellite program is briefly reviewed. A description of orbital coverage and coordinate systems is presented. A brief description of the characteristics of the instruments employed on the Vela satellites for making observations of low or moderate energy charged particles is given. A summary of some of the more significant results is presented in five sections entitled, interplanetary medium, bow shock, transition region, magnetospheric boundary, and magnetospheric cavity. NSA

N66-19185# Centre National de Recherches de l'Espace, Brussels (Belgium).

SOLAR RADIOFLUX AND UPPER-ATMOSPHERE TEMPERATURE

Marcel Nicolet Aug. 1963 50 p refs Presented at the COSPAR Symp., Warsaw, Jun. 1963 Submitted for Publication *Its* Notes Preliminaires No. 33

CFSTI: HC $2.00/MF $0.50

A general analysis of solar radio fluxes between 10^3 and 10^4 Mc/sec was made for an entire solar cycle. It is shown that a correlation between a solar radio flux index and the temperature of the thermopause can be found in the range of 8–10 cm if its basic component is associated with a 27-day mean value. A linear correlation is found between the 27-day mean value of the 8 cm radio flux and the thermopause temperature. However, there is a departure from linearity at 10.7 cm for fluxes of less than 150 units. The oscillation during a so-called 27-day period has a value that is about 50% of the basic component. It is shown that no corpuscular effect is needed in addition to the normal heating of the thermosphere by ultraviolet radiation. A table is given to deduce the relationships between radio fluxes at 8 and 10 cm and average night time and daytime temperature. Finally, the maximum, mean, and minimum temperatures were deduced for night time and daytime conditions between 1952 and 1962. Author

N66-19194*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

OBSERVATIONS WITH UNIVERSITY OF IOWA EQUIPMENT ON MARINER IV, NOVEMBER 1964–FEBRUARY 1965 Preliminary Report

J. A. Van Allen, S. M. Krimigis, and L. A. Frank 22 Feb. 1965 23 p Prepared for JPL *Its* Rept.-65-5

(Contracts NAS7-100; NSG-233-62; JPL-950613)

(NASA-CR-70380) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Observations of electron and proton levels recorded by detectors on the Mariner IV space probe during passage through the earth's magnetosphere and interplanetary space are presented. The detectors consisted of Geiger-Mueller tubes

and a surface barrier solid state proton detector with two discrimination levels. Graphs are plotted for the electron and proton levels in the earth's magnetosphere. The outer boundary of the transition region was found to be at 23 earth radii and there was a single detached spike of low energy electrons at 25.7 earth radii. There was a marked reduction of low energy particles in interplanetary space compared to Mariner II probe data, which may be associated with reduced solar activity. A search for the earth's magnetospheric wake at 3020 earth radii by increased detector counts was negative. Two solar cosmic ray events were recorded. The particles of the first event were identified as protons and not electrons. The second event was complex with decreasing flux of energetic particles. E.A.O.

N66-19199*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
OBSERVATIONS WITH UNIVERSITY OF IOWA EQUIPMENT ON MARINER IV, MAY–OCTOBER 1965 Preliminary Report
S. M. Krimigis, J. A. Van Allen, and L. A. Frank 25 Oct. 1965 25 p refs Prepared for JPL *Its* Rept.-65-36
(Contracts NAS7-100; JPL-950613)
(NASA-CR-70379) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Measurements of solar electron and proton events made with the trapped radiation detector on Mariner IV are presented. Results from interplanetary space obtained from the beginning of May to October 1, 1965, the date on which transmission of data was terminated, are given. Counting rate plots of the events observed during the period are shown; and a tabulation of solar proton and electron events observed during November 28, 1964 to October 1, 1965 is given listing the heliocentric radial distance of the spacecraft; the earth–sun-probe angle; the maximum particle flux; type of event; and class of flare activity as seen from the earth. L.S.

N66-19418# RAND Corp., Santa Monica, Calif.
MULTIPLE SCATTERING IN HOMOGENEOUS PLANE-PARALLEL ATMOSPHERES
T. W. Mullikin Dec. 1965 31 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4846-PR; AD-626205) CFSTI: HC $2.00/MF $0.50

Steady-state multiple-scattering problems for homogeneous plane-parallel atmospheres have been extensively studied by means of the principles of invariance of Ambartsumian and Chandrasekhar. These nonlinear integral equations have been used for computing intensities of radiation on the faces of the atmosphere. Using linear integral-equation theory, it is shown how one computes the source function interior to an atmosphere with optical depth entering the computation only parametrically. Intensities, throughout the atmosphere, are expressed by nonlinear combinations of the computed source function, giving, on the faces, the familiar scattering and transmission functions. By a reduction developed by Sekera, this analysis is applied to Rayleigh scattering including the effects of polarization. Author (TAB)

N66-19427# Michigan Univ., Ann Arbor. Dept. of Astronomy
BASIC SOLAR RESEARCH Annual Report, 1 Oct. 1964–1 Oct. 1965
Orren C. Mohler [1965] 7 p
(Contracts NR-013-205; Nonr-1224(19))
(AD-625026) CFSTI: HC $1.00/MF $0.50

A brief summary is given of work in progress on: Hα flare importance; Solar activity; Photospheric magnetic field in an actively flaring region; Related flares; Level of solar activity during IQSY; Forecasts of solar activity; Hydromagnetic theory and the sun; Wavelength of solar spectrum lines; Magnetic classification of sunspots. TAB

N66-19524*# National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT ACHIEVEMENTS IN PARTICLES AND FIELDS, 1958–1964
1966 99 p refs
(NASA-SP-97) GPO: HC $0.50; CFSTI: MF $0.75 CSCL 20H

Recent data from satellites and space probes on energetic solar plasma, particles, and magnetic fields are reviewed. Topics discussed include: the solar wind and its effect on the earth; the magnetosphere; the transition zone and shock waves; the inner, arbitrary, and outer radiation belts and trapped particles; the earth's magnetic field; solar energetic particles and ground effects; cosmic rays; and neutrons. An extensive bibliography is appended. N.E.N.

N66-19638*# Messinger Consultants Co., San Marino, Calif.
A STUDY OF THE CHARACTERISTICS AND THE SIMULATION OF THE PLANETARY RADIATION ENVIRONMENT
Roger R. Hughes Nov. 1963 198 p refs
(Contract NAS5-9785)
(NASA-CR-71201) CFSTI: HC $5.00/MF $1.25 CSCL 20H

The following major areas of analysis are described: (1) an investigation of the characteristics of the radiant flux encountered by a spacecraft in the vicinity of the earth; (2) a method whereby the distribution of the radiant flux emanating from the earth can be reproduced within the target volume of a space environment simulator; and (3) an estimate of what effect various approximations introduced into the simulated environment will have on the simulation fidelity. Among the specific areas investigated are the geometrical relationships which govern the irradiance of a spacecraft; calculation of the irradiance; and detailed error determinations. C.T.C.

N66-19708*# AVCO-Everett Research Lab., Everett, Mass.
PLASMA RADIATION SHIELDING
R. H. Levy and S. Janes Dec. 1965 29 p refs
(Contracts NASw-1101; AF 49(638)-1553)
(NASA-CR-71254; AMP-179) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The principles of operation of the Plasma Radiation Shield are explained and the current status of research on this project is described. The relationship between this device and others using crossed field electron beams (such as the microwave magnetron) is indicated. Author

N66-19717*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
PLASMA AND SPACE PHYSICS
Frederick L. Scarf [1965] 130 p refs Lecture Notes prepared for the ASEE-NASA Summer Faculty Inst., 1965
(Contract NSR-05-020-88)
(NASA-CR-71028) CFSTI: HC $4.00/MF $1.00 CSCL 20H

Some properties of the fully ionized gases which extend over the vast region of space from the base of the solar atmosphere to the top of the earth's ionosphere are discussed. Brief descriptions are given of the main physical features of the solar corona, the interplanetary medium, the ionosphere and magnetosphere, and collisions and plasma equilibrium, as a basis for detailed examination of the properties of the corona, solar wind, magnetosphere, and transition region. The areas of continuum plasma dynamics, and problems in solar wind theory are also considered. M.G.J.

N66-19749# Harvard Coll. Observatory, Cambridge, Mass. Solar Dept.
CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19-1962 Scientific Report No. 5
Donald H. Menzel and F. Shirley Jones Oct. 1965 119 p (Contract AF 19(628)-3322)
(AFCRL-65-841; AD-625381) CFSTI: HC $4.00/MF $0.75

This report contains a tabulation and analysis of the behavior classification of prominences observed during 1962 at the Sacramento Peak Observatory, Sunspot, New Mexico. TAB

N66-19751# American Science and Engineering, Inc., Cambridge, Mass.
THE ENERGETIC CHARGED PARTICLE ENVIRONMENT OF THE EARTH HITCH-HIKER I DATA ANALYSIS Final Report, 15 May 1964–14 Aug. 1965
Frank R. Paolini, George C. Theodoridis, and Michael Bate Bedford, Mass., AFCRL, 13 Sep. 1965 150 p refs (Contract AF 19(628)-4207)
(ASE-1056; AFCRL-65-692; AD-625690) CFSTI: HC $4.00/MF $1.00

The results of the reduction and analysis of data obtained from instrumentation flow on the Air Force Satellite Hitchhiker I (1963-25B) are presented. The instrumentation included two electrostatic analyzers (one for electrons, 15 to 100 kev, the other for protons, 15 to 100 kev); a scintillation spectrometer (for electrons, 0.7 to 4.0 Mev); a phoswich scintillation spectrometer (for protons 1. to 5. Mev and 7.5 to 120 Mev); and a Geiger counter (electrons greater than 4. Mev, protons greater than 40. Mev). Detailed data on integral energy spectra, pitch angle distributions, and perpendicular unidirectional intensities, as functions of B, L (or λ, L) and time are given in five papers appended to this report. No substantial intensities of protons, 15 to 100 kev, were observed. Electrons, 15 to 100 kev were observed with intensities as great as 2×10^5/sq cm-sec-ster-kev at 40 kev, but the anomalous angular distributions obtained cast doubt on the credibility of these data. Peak inner belt intensities for electrons above 1 Mev were about 5×100,000 electrons/sq cm sec ster at L approx. 1.6. TAB

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-18486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIVE YEARS OF SOVIET SPACE INVESTIGATION
M. G. Kroshkin and V. G. Samarin 25 Oct. 1965 23 p refs Transl. into ENGLISH from Geofiz. Byul. (Moscow), v. 13, 1963 p 80–93
(FTD-MT-65-64; AD-625300) CFSTI: HC $1.00/MF $0.50

This survey is a short reference of the basic stages of space investigations carried out in the Soviet Union during the five years (1958–1962) of the space era. Data are given on all Soviet spacecraft launched in 1957–1962. Author (TAB)

N66-18487# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
RESULTS OF SPACE TRIANGULATION ADJUSTMENTS FROM SATELLITE DATA
Armando Mancini and Lawrence A. Gambino Sep. 1965 29 p Presented at the 2d Intern. Symp. on the Use of Artificial Satellites for Geodesy, Athens, 26–30 Apr. 1965
(GIMRADA-RN-13; AD-625258) CFSTI: HC $2.00/MF $0.50

Simultaneous optical observations from the $\beta\mu$-1-1962 satellite have been used to calculate the three-dimensional orientation and geodetic azimuths of lines ranging from 400 km to 1600 km in length. These directions were subsequently used as input to a conventional first-order triangulation adjustment and a three-dimensional surface adjustment to establish the geodetic positions of the camera sites. It is concluded from this study that the station-to-station directions can be computed within an accuracy of 0.7 sec for the three-dimensional fix and to within 0.5 sec for the geodetic azimuth. The convantional and three-dimensional adjustments produce an average root-mean-square error of 6 m in position. Author (TAB)

N66-18531# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SOME PERIODIC TRAJECTORIES IN CISLUNAR SPACE VERY RESTRICTED FOUR BODY APPROXIMATION
Raymond Earl Siferd (M.S. Thesis) Aug. 1965 129 p refs (GA/MECH/65-40; AD-625373) CFSTI: HC $4.00/MF $1.00

The possibility of existence of periodic or nearly periodic trajectories in cislunar space is investigated. In cislunar space, the motion is determined by the gravitational fields of the earth, moon, and sun. The problem is studied using the very restricted four body approximation. It is assumed that the earth and moon revolve in circular paths about their barycenter and the barycenter of the earth and moon moves in a circle above the sun. The motion of the infinitesimal fourth body is restricted to the plane of the three finite bodies. The equations of motion are integrated numerically using a digital computer. A class of periodic or nearly periodic trajectories is found in cislunar space. The period of each trajectory is approximately 29.53 days with respect to a coordinate system centered at the earth–moon barycenter and rotating at the rate the moon rotates about the earth. Periodic trajectories are found which circle the earth, the moon, and the earth-moon L libration point. Author (TAB)

N66-18538# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
TURN OF THE ORBIT'S PLANE OF ARTIFICIAL EARTH SATELLITE [K ZADACHE O POVOROTE PLOSKOSTI ORBITY SPUTNIKA]
Yu. M. Kopnin Oct. 1965 27 p refs Transl. into ENGLISH from Kosmicheskiye Issled. (Moscow), v. 3, no. 4, Jun.–Aug. 1965 p 540–553
(TC-952; AD-625882) CFSTI: HC $2.00/MF $0.50

Motion equations are formulated for satellite motion as a material point in the central field of the earth's gravity, and movable coordinates of axis are introduced into the orbital plane for visually interpreting the spatial motion. Dependent variables are substituted, and the equations are reduced for linearity and nonsingularity. Solutions are also given for several cases of integration, where a satellite's motion component changes under perturbing acceleration. Problems connected with the turn of the circular orbit's plane by a defined angle are analyzed, equations are derived, and Pontryagin's principle of maximum is employed in the solution. E.A.O.

N66-18620# Naval Radiological Defense Lab., San Francisco, Calif.
TEMPERATURES OF METEOROIDS IN SPACE
Clay P. Butler 4 Nov. 1965 27 p refs
(USNRDL-TR-927; AD-626105) CFSTI: HC $2.00/MF $0.50

On the basis of reported optical measurements of iron and stony meteorites, upper and lower limits for solar absorptance and hemispherical emittance of such surfaces have been tentatively established. Temperatures of three classes of meteoroids, none larger than 10 meters in radius have been calculated for various orbits and alpha/epsilon ratios. These classes are light chondrites, dark chondrites, and the irons. Temperatures for a meteoroid in a Mercury orbit range from 100°C for a light chondrite to 400°C for an iron.
Author (TAB)

N66-18645# University Coll., London (England).
THE COLLAPSE OF INTERSTELLAR GAS CLOUDS Annual Summary Report, 1964–1965
D. Mc Nally Nov. 1965 26 p refs
(Contract N62558-4281)
(AD-626221) CFSTI: HC $2.00/MF $0.50

The report sets out the work done in three categories on star formation: (1) the numerical methods developed for following the evolution of collapsing gas clouds, (2) the development of initial data permitting the study of gas clouds with a wide range of initial density distributions, (3) the preliminary results obtained while developing (1) above. It is proposed to develop these studies further and to produce a catalogue of interstellar spectral features. Author (TAB)

N66-18658# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MINIMUM FUEL TRAJECTORIES FOR THRUST LIMITED ROCKETS IN AN INVERSE SQUARE GRAVITY FIELD
Kenneth Edward Needham (M.S. Thesis) Aug. 1965 64 p refs
(GA/MECH/65-38; AD-625395) CFSTI: HC $3.00/MF $0.75

Minimum fuel trajectories for motion of a rocket in an inverse square gravity field are analyzed. The equations of motion are derived and expressed in terms of non-dimensional parameters making the equations applicable to any inverse square force field. The necessary condition for a minimum fuel path is obtained by using Pontryagin's Maximum Principle. Using a trial and error method of solution the optimal control of thrust direction and magnitude is determined and the results are presented as functions of range for three initial thrust to weight ratios. Ranges of 2 to 65 miles on the surface of the moon for initial thrust to weight ratios of approximately 1.6, 1.9, and 2.4 are considered. The solutions obtained are compared with solutions for minimum fuel trajectories in a uniform parallel gravity field. Author (TAB)

N66-18664# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF THE EFFECT OF LAUNCH SITE LOCATION AND VARIATION OF LAUNCH PARAMETERS ON LUNAR-EARTH TRAJECTORIES
Paul Stuart Skartvedt (M.S. Thesis) Aug. 1965 97 p refs
(GA/MECH/65-41; AD-625394) CFSTI: HC $3.00/MF $0.75

Lunar-earth trajectories are examined to determine the sensitivities of earth re-entry angle and velocity to changes in both static and dynamic lunar launch parameters. These trajectories are classified as free return single pass trajectories with no guidance or delta capability considered. The equations of motion for the trajectories are derived from the restricted problem of three bodies in a rotating coordinate system. The earth and moon are considered to rotate about their barycenter in a circular orbit at a constant rate of rotation. The equations of motion do not permit closed form solutions and are programmed for solution on the IBM 7094 Digital Computer in Fortran IV language using Runge-Kutta-Gill numerical integration methods. Two lunar longitude launch locations with five latitude locations for each longitude were investigated. At each location launch angles and velocities were introduced which would result in an earth re-entry angle of approximately five degrees with the local horizontal. For these initial conditions, sensitivities to change of launch velocity, launch azimuth angle and launch elevation were determined. The results showed that an increase in launch velocity caused an increase in all sensitivity coefficients; that re-entry angle was most sensitive to change in launch azimuth angle, and that re-entry velocity is solely a function of launch velocity. Author (TAB)

N66-18666*# National Aeronautics and Space Administration, Washington, D. C.
APOLLO LUNAR SCIENCE PROGRAM, REPORT OF PLANNING TEAMS. PART II: APPENDIX
Dec. 1964 210 p refs
(NASA-TM-X-57274) CFSTI: HC $6.00/MF $1.25 CSCL 22A

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12. NEED FOR LUNAR ATMOSPHERE MEASUREMENTS IN THE APOLLO PROGRAM 13 p (See N66-18678 09-30)

N66-18667* National Aeronautics and Space Administration, Washington, D. C.
PROJECT APOLLO GEOLOGICAL FIELD INVESTIGATIONS
Edward N. Goddard, J. Hoover Mackin, E. M. Shoemaker, and Aaron C. Waters *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 28 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Objectives of geological field investigations in the Apollo scientific program are to obtain complete and accurate knowledge of the nature and structure of the lunar surface and to

determine the regional stratigraphic and petrologic character of the Moon at various landing sites. It appears highly likely that the Moon's surface is covered with a layer of finely-broken rock fragments; thickness of the layer, size distribution of the rock fragments, and size and spacing of the superimposed craters have to be determined. Both sampling and in situ measurements of physical and engineering properties of lunar surface materials are advocated. Astronauts should be familiar with geological methods and able to handle the following equipment: (1) Jacob's staff sampling devices; (2) audio system and recorder; (3) lightweight geologist's pick, magnifying lens, and marking tool; and (4) sample collecting equipment. G.G.

N66-18668* National Aeronautics and Space Administration, Washington, D. C.

SAMPLING AND EXAMINATION OF LUNAR SURFACE MATERIALS Preliminary Report

Eugene N. Cameron (Wisconsin Univ.), Edward C. T. Chao (Geological Survey), Clifford Frondel (Harvard Univ.), and Harry H. Hess (Princeton Univ.) *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 12 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

A guideline for sampling, packaging, transportation, and preparation of lunar rock surface materials is presented. Preliminary examination of the samples will consist of bacteriological evaluation, possible interactions of the sample constituents with the terrestrial environment, measurements of its physical properties, and a description of their minerology, petrography, and physical nature. Detailed geological examinations will include quantitative chemical analyses; X-ray and morphological crystallographical descriptions; physical evaluation of crystal phases; petrographic descriptions of solid aggregates; studies of phase transformations and equilibrium; and exposure to terrestrial environmental conditions. G.G.

N66-18669* National Aeronautics and Space Administration, Washington, D. C.

GEOCHEMISTRY PLANNING TEAM First Report

In its Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 30 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

The geochemical portion of the Apollo science program is discussed and a proposed schedule of experiments for lunar samples is outlined. Early experiments should be confined to those (1) where information will be lost by waiting, or (2) which can yield preliminary data useful for planning later experiments. A part of the sample should be set aside as reserve for the distant future. First stage experiments include gamma ray spectra, sensitive structural studies, and gas determinations. Later experiments will be micro- and semimicroanalyses, X-ray fluorescence for major constituents, electron microprobes, quantitative spectrographic analyses, and neutron activation analyses. G.G.

N66-18670* National Aeronautics and Space Administration, Washington, D. C.

PASSIVE LUNAR SEISMIC EXPERIMENT

F. Press, M. Ewing, G. H. Sutton, and R. Kovach *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 9 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

An Apollo passive seismic system composed of a three-axis seismograph and capable of responding to short and long periods of seismic waves, is proposed. It should be designed to operate for six month continuously after being placed on the moon's surface by an astronaut. An additional single short period vertical seismometer should serve as backup device. Central multiplexers and AD converters for all experiments are recommended. Meteorite impacts would provide the seismic sources and lead to the establishment of epicenters. G.G.

N66-18671* National Aeronautics and Space Administration, Washington, D. C.

ACTIVE LUNAR SEISMIC EXPERIMENT

J. M. De Noyer and G. Simmons *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 8 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Active lunar seismological experiments will utilize mortars to deploy explosive charges and thus provide the seismic source for observation of elastic wave properties of the lunar surface and interior to a depth of about 500 feet. This experiment should be set up by the astronaut but its performance deferred until he has departed and until all other other experiments have completed their functions. G.G.

N66-18672* National Aeronautics and Space Administration, Washington, D. C.

LUNAR GRAVITY MEASUREMENTS

J. Weber and G. J. F. Mac Donald *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 10 p refs (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Precise measurements of the acceleration due to gravity on the lunar surface over a period of months may yield valuable information concerning the internal constitution of the moon. The moon will interact with gravitational radiation. The lunar free oscillations may be observed to be excited by such radiation if the power spectrum is sufficiently intense over the frequencies of certain of the moon's normal modes. Simultaneous observation of the earth's normal mode excitation will make it very likely that the effects are due to gravitational waves. Observations are planned using a lunar gravimeter having a weight less than 30 pounds, a volume less than one cubic foot, power consumption less than 5 watts continuously, and less than 15 watts with 30% duty cycle. This device will continuously monitor the lunar gravitational field, recording changes greater than about one part in 10^9. Author

N66-18673* National Aeronautics and Space Administration, Washington, D. C.

MAGNETIC MEASUREMENTS IN THE APOLLO PROGRAM

Norman F. Ness, James Balsley, Richard R. Doell, and Victor Vacquier *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 15 p refs (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

In order to investigate the spatial properties of the lunar magnetic field and the interaction of the solar plasma with the moon, a mapping by circumlunar satellites is required. Transient properties can be measured at several points of the lunar surface and results can be cross correlated to determine the electrical characteristics of the moon as they affect fluctuating magnetic fields. Sampling of unweathered and physically stable surface materials is necessary to investigate the magnetic properties and the magnetic history of lunar rocks. It is important that the orientation and age of the obtained samples is determined with respect to a lunar set of coordinates. G.G.

N66-18674* National Aeronautics and Space Administration, Washington, D. C.

LUNAR HEAT FLOW MEASUREMENT Preliminary Report

S. P. Clark (Yale Univ.), A. H. Lachenbruch (Geological Survey), R. Von Herzen, and M. G. Langseth *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 17 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Methods to determine the heat flux from the interior of the moon, and the thermal properties of lunar surface materials are explored. Infrared measurements of the lunar surface radiation showed a temperature fluctuation from 120°K to nearly 400°K during a 28-day lunation. Temperature gradient measurements must, therefore, be made at depth where the variations are small. Three simple thermal experiments are recommended for observation of lunar surface heat flux, surface temperature fluctuations and their propagation into the subsurface, and the thermal properties of lunar surface materials at several locations. Proposed are: (1) temperature and conductivity measurements at three points in drilled holes 3 to 5 m below the moon's surface; (2) temperature measurements as a function of depth and time in the penetrable lunar surface material of an undisturbed area on the moon's surface; and (3) temperature measurements as a function of depth and time in the surface material of the moon beneath an area covered by an insulating blanket. G.G.

N66-18675* National Aeronautics and Space Administration, Washington, D. C.
REPORT OF THE BIOSCIENCES PLANNING TEAM
In its Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 18 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Biological contamination of the moon by earth bacteria and the possible back contamination of earth by lunar organisms is evaluated. Ventilation of the LEM atmosphere through an ultra-high efficiency filter upon arrival on the moon surface is strongly recommended in order to prevent the escape of viable microorganisms and particulate chemical contaminants from the module. Bacterial leakage from the astronauts space suits will present no serious problems because such contamination can not travel far from the astronaut due to the lack of a proper atmosphere as transport medium. It is recommended that the astronauts clean the outer surfaces of their garments with a damp cloth containing a bactericide before leaving the space cabin. Quarantine of the returning astronauts might prevent the introduction of lunar pathogens into the terrestrial environment. G.G.

N66-18676* National Aeronautics and Space Administration, Washington, D. C.
MISSION PROFILES
In its Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 12 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

A mission work statement is presented that includes objectives, constraints, and guidelines for planned scientific activities of the astronauts after a lunar landing. Sample mission profiles cover geological, geophysical, and geochemical parameter studies of the landing sides; investigations of the physical and chemical properties of the lunar atmosphere; and the recovery of rock samples for further study on earth. Also included are radiation monitoring outlines for crew safety and other safety measures. G.G.

N66-18677* National Aeronautics and Space Administration, Washington, D. C.
FOUR HOUR LUNAR NORMAL AND ALTERNATE MISSIONS Preliminary Study
D. Beattie, E. Davin, and P. Lowman *In its* Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 17 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Possible scientific investigation to be carried out during Apollo lunar landings with four hours available for surface operations are discussed. The geological traverse evolved as the most valuable scientific operation. A table presents a probable distribution of scientific studies among the assumed seven Apollo Missions. G.G.

N66-18678* National Aeronautics and Space Administration, Washington, D. C.
NEED FOR LUNAR ATMOSPHERE MEASUREMENTS IN THE APOLLO PROGRAM
In its Apollo Lunar Sci. Program, Rept. of Planning Teams. Part II: Appendix Dec. 1964 13 p (See N66-18666 09-30) CFSTI: HC $6.00/MF $1.25

Gas analyses at the lunar surface will be of value in determining geological processes, especially those involving magma generation, that were or are present within the moon. Lunar atmospheric measurements should cover: (1) total pressure, (2) mass spectrum, and (3) the following ionic constituents—total concentration, mass spectrum, and directed flux. A mass spectrometer to measure the neutral gas composition and an ion mass spectrometer for ion composition evaluation are recommended for lunar scientific observations. G.G.

N66-18679# Kodaikanal Observatory (India).
ANNUAL REPORT OF THE KODAIKANAL OBSERVATORY FOR THE YEAR 1963
M. K. Vainu Bappu [1964] 12 p refs
(DGO-47.63) CFSTI: HC $1.00/MF $0.50

Synopses of results for solar, magnetic, ionospheric, and ozone observations made at Kodaikanal, India, are presented. Emphasis was placed on photometric and telescopic studies of velocity field distributions in sunspots, heliographic observations of solar prominence activities, and examination of geomagnetic effects associated with relativistic flares. G.G.

N66-19032*# Martin Co., Baltimore, Md.
VIRTUAL MASS TECHNIQUE FOR COMPUTING SPACE TRAJECTORIES Final Report
D. H. Novak Jan. 1966 106 p
(Contract NAS9-4370)
(NASA-CR-65227; ER-14045) CFSTI: HC $4.00/MF $0.75
CSCL 22C

This study has demonstrated the feasibility of the Virtual Mass Technique for computing space trajectories and has developed a FORTRAN IV digital computer program for solving the restricted three-body problem by this procedure. The virtual mass at any instant of time replaces the combined gravitational effects of all the real celestial bodies upon a spacecraft. The magnitude and location of this fictitious body, along the line of the instantaneous resultant force vector, are uniquely computed by formulas derived from the generalization of the gravispheric force center concept. The computational procedure is based upon the assumption that, over a small time interval, the spacecraft motion can be represented as a two-body conic section arc relative to the moving and varying virtual mass. In this manner the complete trajectory is computed as a series of such arcs, pieced together in a stepwise manner—updating the position and magnitude of the apparent force center at each step. Author

N66-19039*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NO. 1

15 Jan. 1966 67 p
(NASA-TM-X-56876; X-537-65-217) CFSTI: HC $3.00/MF $0.75 CSCL 22C

Data compiled and computed by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory are presented as the satellite situation report. For objects in orbit, information includes object designation, code name, catalogue number, source, launch date, orbital parameters, and transmitting frequencies for some objects. Decayed objects have identification data and dates of decay listed. E.A.O.

N66-19041*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-36, VOLUME IV FOR THE PERIOD OCTOBER 1, 1965 TO NOVEMBER 30, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Dec. 1965 362 p refs
(Contract NAS7-100)
(NASA-CR-70851; JPL-SPS-37-36, Vol. IV) CFSTI: HC $7.00/MF $2.00 CSCL 22D

Project activities on various space exploration programs are summarized. These include the research and development efforts in such areas as: *Systems*—systems analysis, scientific programming, and deep space networks; *Guidance and Control*—spacecraft power and control; *Engineering Mechanics*—materials, and applied mechanics; *Propulsion*—advanced concepts, polymer research, liquid propulsion, and solid propellant engineering; *Space Sciences*—space instruments, lunar and planetary sciences, bioscience, fluid physics, and physics; *Telecommunications*—spacecraft telemetry and command, communications elements, spacecraft radio, information processing, detection theory, mathematical research, and combinatorial communications. E.A.O.

N66-19107 Florida Univ., Gainesville.
FUNDAMENTALS OF SPACE MANEUVERS: FORCES AND ORBITS IN A NEWTONIAN FORCE FIELD
Mark H. Clarkson *In its* Nucl. Rocket Propulsion 1964 p 2–29 (See N66-19106 09-22)

Equations are formulated for determining the forces and orbits in a Newtonian force field, and applied to the two-body problem. A simplified analysis of a trip to the moon is also presented, with the following phases considered: vertical ascent, injection into a circular orbit, transfer to a cislunar orbit, transfer to a lunar orbit, and landing maneuver. Calculations for each phase are given, based on the previously obtained equations. M.G.J.

N66-19170*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF LUNAR AND SOLAR EFFECTS ON THE MOTION OF CLOSE EARTH SATELLITES
James P. Murphy and Theodore L. Felsentreger Nov. 1965 58 p refs Revised
(NASA-TM-X-55367; X-547-65-251, Rev.) CFSTI: HC $3.00/MF $0.50 CSCL 22A

Theoretical and experimental studies indicate that long periodic lunar and solar forces produce perturbations in the orbital elements of close earth satellites comparable to perturbations caused by the earth's oblateness. Analytic formulas for the principal secular and long period luni-solar gravitational perturbations, as well as long period expressions for solar radiation pressure effects (neglecting the earth's shadow), are given. The formulas were programmed, and were used to analyze the motions of the Relay 1 and Telstar 2 satellites. Author

N66-19182# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF SEISMIC STUDIES ON THE MOON
V. N. Zharkov 16 Feb. 1966 21 p Transl. into ENGLISH from Zemlya i Vselennaya (Moscow), no. 6, Nov.–Dec. 1965 p 16–23
(JPRS-34142; TT-66-30584) CFSTI: $1.00

Selenological characteristics of the moon are reviewed, and a moon model is discussed. Theoretical data are given for pressure and density distributions, gravitational acceleration, and heat flux in the interior. Possible modes of seismic wave propagation and possible results are considered. The complexity of lunar seismic study is indicated to lie in delivering the instrument to the moon, placing it, and transmitting the data to the earth. N.E.N.

N66-19424# RAND Corp., Santa Monica, Calif.
A COMPARISON OF U.S. AND SOVIET EFFORTS TO EXPLORE MARS
Bruce C. Murray (Calif. Inst. of Tech., Pasadena), and Merton E. Davies Jan. 1966 42 p refs Prepared in cooperation with Calif. Inst. of Tech.
(P-3285; AD-626935) CFSTI: HC $2.00/MF $0.50

Contents: The U.S. program: The Mariner C program; The Atlas/Centaur program; The Voyager program. The Soviet program: History of the program; Photographic efforts and capability; Scientific objectives. Comparison of past efforts; Comparative technological achievements; Comparative scientific objectives and achievements; Future prospects for the Soviet programs; Future prospects for the U.S. program. TAB

N66-19453*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR STRUCTURE AS DEDUCED FROM MUONG NONG TEKTITES
J. A. O'Keefe and I. Adler Jan. 1966 34 p refs Presented at the Caltech/JPL Symp. on the Surface of the Moon, Lunar and Planetary Conf., 13–15 Sep. 1965 Submitted for Publication
(NASA-TM-X-55418; X-640-66-23) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A discussion is presented on the Muong Nong tektites, their chemical composition and structure, and includes several viewpoints on its nature and arguments supporting its lunar origin. A hypothesis is suggested that ash flow processes on the moon provide a reasonable explanation of the Muong Nong tektite structures, and at the same time of some lunar craters and lunar red spot observations. R.N.A.

N66-19480*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DETERMINATION OF THE ORIENTATION OF A UNIFORMLY ROTATING OR RAPIDLY ROTATING VEHICLE UTILIZING THE OUTPUTS FROM SOLAR SENSORS AND A LATERAL MAGNETOMETER
Richard H. Ott, Jr., Henry M. Horstman, and Richard M. Lahn Mar. 1966 55 p refs
(NASA-TM-X-55424; X-721-66-95) CFSTI: HC $3.00/MF $0.50 CSCL 22A

A general procedure is developed to determine the attitude of the longitudinal axis (spin axis) and a lateral axis (experiment axis) of a rotating vehicle from the output of solar sensors and a lateral magnetometer. The orientation of the solar vector with respect to a rocket-axis system is obtained from solar sensors located both on the side and on the nose of the rocket. The lateral magnetometer is used to obtain the location of the component of the magnetic field vector along the lateral plane of the rocket. The location of the longitudinal

axis and a lateral (experiment) axis of the vehicle in both horizon coordinates and space fixed coordinates is calculated by the use of various coordinate transformations. The method is programmed on an IBM 7094 computer. An explanation of the computer operations and a copy of the computer program is included. A particular rocket is used as a sample case and the results are presented as time histories of the zenith and azimuth angles (horizon coordinates) and the right ascension and declination (space fixed coordinates) of both the longitudinal and experiment axes. Author

N66-19481*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A NOTE ON LAMBERT'S THEOREM

E. R. Lancaster, R. C. Blanchard, and R. A. Devaney Feb. 1966 16 p refs

(NASA-TM-X-55420; X-643-66-35) CFSTI: HC $1.00/MF $0.50 CSCL 03C

Through appropriate choice of parameters and independent variable, various cases of Lambert's theorem are combined into a single form. The theorems for elliptic and hyperbolic transfers are given, and equations for both cases are formulated. A similar procedure also holds for the parabolic case. It is pointed out that this method is particularly convenient for numerical work. N.E.N.

N66-19488*# California Inst. of Tech., Pasadena.

NEUTRON STARS

John N. Bahcall and Richard A. Wolf [1964] 13 p refs Submitted for Publication

(Grant NGR-05-002-028; Contract Nonr-220(47))

(NASA-CR-60234) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Results are presented and implications suggested for some approximate calculations for the neutrino cooling rates of neutron stars. Also, it is pointed out that some current ideas regarding the constituents of neutron stars should be revised. The description of the states of a neutron star and the reactions by which it cools differs from previous works. This description includes an approximate, self-consistent effect of the strong interactions among all the hadrons present. The principal results obtained (for densities not much greater than nuclear densities) are: (1) the existence of effective masses for all the hadrons, (2) differential shifts in the threshold densities at which various kinds of particles are produced, and (3) much faster cooling rates than previous works estimated. C.T.C.

N66-19497*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

USE OF ENTRY VEHICLE RESPONSES TO DEFINE THE PROPERTIES OF THE MARS ATMOSPHERE

Alvin Seiff and David E. Reese, Jr. [1965] 31 p refs Presented at the Am. Astronautical Soc. Symp. on Unmanned Exploration of the Solar System, Denver, 8–10 Feb. 1965

(NASA-TM-X-56125) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Principles are developed by which the atmospheric properties of an unknown planetary atmosphere can be deduced from responses of a probe vehicle entering the atmosphere. Experiments to determine atmospheric density and pressure as functions of altitude, and to detect and determine quantities of selected gases in the atmosphere are examined in detail. Probe geometries are discussed and take lift, drag coefficient, Mach number, Reynolds number, gas composition, and angle of attack into consideration. The approach to the detection of atmospheric species is by spectrometry of selected wavelengths of emission from the hot atmospheric gases in the shock layer. Laboratory studies and theory show that very bright emission behind the bow wave in atmospheres of nitrogen and carbon dioxide is associated with the cyanogen radical, and detection of the violet band system would constitute direct evidence for nitrogen in the atmosphere. Other radiometers to measure the nitric oxide and argon radiations are discussed. C.T.C.

N66-19498*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RECENT MEASUREMENT OF THE MAGNETIC FIELD IN THE OUTER MAGNETOSPHERE AND BOUNDARY REGIONS

J. P. Heppner Nov. 1965 59 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965 Submitted for Publication

(NASA-TM-X-55407; X-612-65-490) CFSTI: HC $3.00/MF $0.50 CSCL 03B

Within the framework of a brief review of recent magnetic field measurements in space, attention is directed to initial findings from the EGO-1 (OGO-A) satellite. Two particularly important results are: (1) circularly polarized, coherent oscillations of large amplitude are found at the bow shock front discontinuity, and (2) during periods of general magnetic disturbance when the magnetospheric tail field intensity is high, temporary decreases in tail field intensity are found to follow the onset of auroral zone negative bays in the same local time sector. This suggests that during the peak auroral activity which accompanies the onset of negative bays, the tail field in the bay sector partially collapses, or relaxes, from its highly stressed state. An abnormal distortion of the outer magnetosphere on the day side of the earth coincides with the occurrence of an auroral zone positive bay near the same meridian. These correlations make it evident that a common mechanism is responsible for major changes in the outer magnetospheric field and the magnetic bays accompanying aurora. Author

N66-19502*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HIGH-RESOLUTION LUNAR-BASED TELESCOPES FOR COSMOLOGICAL STUDIES

Kenneth L. Hallam Apr. 1965 27 p refs

(NASA-TM-X-56418; X-614-65-171) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Optical observations from lunar-based high-resolution telescopes are shown to be required to provide many of the necessary observational discriminants between various cosmological models. Unsurmountable observational limitations set by the earth's atmosphere are discussed. Basic instrumental requirements for lunar-based telescopes are developed, with emphasis on their application to the solution of the cosmological problem. Author

N66-19506*# Aracon Geophysics Co., Concord, Mass.

TIROS VII ATTITUDE SUMMARY. VOLUME III: ORBITS 8000–11850 Third Technical Summary Report, 11 Dec. 1964–29 Aug. 1965

Adrienne Zenuk Dec. 1965 176 p refs *Its* Rept.-9620-9

(Contract NAS5-9547)

(NASA-CR-71081) CFSTI: HC $5.00/MF $1.00 CSCL 22A

Operational definitive attitude data are presented in graphical and tabular form for orbits 8,000 through 11,850 from 11 December 1964 to 29 August 1965. Also included is a table of orbital elements for 18 April 1965, along with a map showing the subpoint track. D.T.

N66-19525*# National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT ACHIEVEMENTS IN PLANETARY ATMOSPHERES 1958–1964
1966 65 p refs
(NASA-SP-98) GPO: HC $0.45; CFSTI: MF $0.75 CSCL 03B

Recent advances resulting from satellite and rocket soundings in the study of the Earth's atmosphere above 30 km, and of Mars', Venus', and Jupiter's atmospheres are discussed. Among the findings reported about the Earth's atmosphere are: an isothermal temperature distribution above 300 km with diurnal and solar activity variations, the role of molecular diffusion in the gravitational field in controlling constituent distributions, the large atmospheric density variations, strong shear zones from 70 to 120 km. Discussed also are hydrogen geocorona, auroral emissions excited by energetic electrons, and micrometeoroid impact rates and densities. An extensive bibliography is included. N.E.N.

N66-19528*# Stanford Univ., Calif. Radio Science Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report No. 6, 1 Jul.–31 Dec. 1965
V. R. Eshleman Jan. 1966 16 p refs
(Grant NsG-377)
(NASA-CR-71090) CFSTI: HC $1.00/MF $0.50 CSCL 03A

Radar and radio studies of lunar and planetary ionospheres, atmospheres, and surfaces, and of the sun and interplanetary mediums were continued. In the cislunar gas studies, the ionospheric electron contents, determined by the Faraday rotation method, were subtracted from each radar determination of total content, and the existence of two distinct regions beyond the ionosphere was reaffirmed. The simultaneous Doppler and Faraday lunar radar data showed that these two methods produce similar conclusions about cislunar magnetospheric wake density. A digital radio polarimeter was used to observe radio noise bursts at 22.2 Mc from Jupiter and the sun. Jovian emission was felt to confirm the predominance of right hand polarization, and the solar burst analysis showed no chage of either axial ratio or orientation of ellipse from burst to burst. A signal channel coding scheme for additive noise channels with feedback was developed and considered to operate successfully under a sizeable code book. Among the other programs mentioned are planetary surface mapping, planetary atmosphere and ionosphere studies, plasma effects on space probe tracking, and receiver construction techniques. N.E.N.

N66-19537*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
EL CAMPO SOLAR RADAR SYSTEM Second Semiannual Report, Jul. 1–Dec. 31, 1965
J. V. Harrington [1965] 12 p
(Grant NGR-22-009-064)
(NASA-CR-71096; CSR-PR-4539-2) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The Doppler spectra of solar radar echoes were investigated; and various mathematical models for high corona echoes were examined. It is pointed out, with respect to the main echoes, that high corona echoes have unusual Doppler characteristics, and that their existence implies irregularities which have ionization densities several hundred times the mean coronal density. Further, it is suggested that the disturbances responsible for these high corona echoes are present simultaneously all over the sun. Data taken since 1961 were analyzed, and then averaged for three month periods. Cross sections, average range depth, and mean range depth were all found to vary with sun spot numbers. Other experiments performed include: (1) the production of two circularly polarized components of echo energy and solar noise; (2) a monitoring of Jupiter at 38 Mc/s; (3) various theoretical investigations pertaining to the solar reflection process; and (4) a drawing of a sky map of contour lines of constant galactic temperature at 38 Mc/s. Finally, it is hypothesized that the ionization irregularities are caused by some type of hydromagnetic shocks propagating radially outward. D.T.

N66-19541*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DETERMINATION OF STATION COORDINATES FROM OPTICAL OBSERVATIONS OF ARTIFICIAL SATELLITES
Walter J. Köhnlein 20 Oct. 1965 32 p refs
(Grant NsG-87)
(NASA-CR-71100; SAO Special Rept.-189) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Improvements of station coordinates and corrections to the nonzonal harmonics of the geopotential were computed from a combined dynamical and geometrical method using standard least-squares procedures. Author

N66-19575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN EXPLOIT WHICH HUMANITY WILL NOT FORGET
F. Lushnikov 7 May 1965 15 p Transl. into ENGLISH from Krasnaya Zvedza (Moscow), 14 Dec. 1963 p 3-4 (FTD-TT-64-1379/142; AD-615988) CFSTI: HC $1.00/MF $0.50

Translations of excerpts from the logbooks kept by the Russian astronauts Lt. Col. V. Bykovskiy and the woman, Valya Tereshkova, during their 1963 flights in VOSTOK 5 and VOSTOK 6. TAB

N66-19605*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DEVELOPMENT OF HANSEN'S COORDINATES IN THE LUNAR PROBLEM BY THE METHOD OF ITERATION
Milton L. Charnow Washington, NASA, Mar. 1966 107 p refs
(NASA-TN-D-3378) CFSTI: HC $4.00/MF $0.75 CSCL 03B

A modification of Hansen's solution of the lunar problem by Musen has been programmed and verified by duplicating some of Hansen's series. Methods were developed for manipulating trigonometric series with numerical coefficients and literal arguments. The program described will be used to calculate perturbations and ephemerides of both natural and artificial satellites. Author

N66-19608*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PERTURBATIONS OF A SYNCHRONOUS SATELLITE RESULTING FROM THE GRAVITATIONAL FIELD OF A TRIAXIAL EARTH
C. C. Barrett 10 Sep. 1962 29 p refs *Its* Mission Analysis Rept. Mar. 2
(NASA-TM-X-55349; X-623-62-160) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This paper presents a study of the nature of the 24 hour synchronous satellite perturbations due to the earth's triaxiality. Equations representing the drift due to these perturbations are developed. It is found that the radial drift is linear and the longitudinal drift is parabolic. Both have superimposed on these primary curves, oscillations with one day periods. This analysis also verifies the existence of only two dynamically

stable points, where no drift due to the earth's triaxiality will occur. These are located at opposite ends of the equatorial minor axis. Author

N66-19623# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
THE IRRELEVANCE OF BALDWIN'S RELATIONSHIP FOR DECIDING THE CAUSE OF LUNAR CRATER FORMATION
G. S. Shteinberg Jan. 1966 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 1, 1965 p 55–57
(T-446-R) CFSTI: HC $1.00/MF $0.50

The meteoritic hypothesis of lunar crater formation is compared to the volcanic theory of origin. It is pointed out that the largest features morphologically resembling lunar craters are volcanic calderas. A graph, depicting the relationship between the energy of volcanic eruptions and the size of the calderas, shows that the calderas lie on the same curve as that established for shell craters, meteorite craters, nuclear explosion craters and lunar craters. Although lunar craters obey the same rules established for explosion craters, it was felt that this is not conclusive proof that they had a meteoritic origin since these same rules also hold for volcanic features. Analysis of the existing data shows that the either–or formulation of the problem of the causes responsible for the formation of the lunar surface relief prevents a satisfactory explanation for all the observed facts. Analysis of photographs of the moon's surface should provide additional data for further study. H.S.W.

N66-19631*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-37, VOLUME VI FOR THE PERIOD NOVEMBER 1, 1965 TO DECEMBER 31, 1965. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Jan. 1966 39 p refs
(Contract NAS7-100)
(NASA-CR-71206; JPL-TM-33-232) CFSTI: HC $3.00/MF $0.50 CSCL 03C

Project activities, supporting research, and advanced development efforts are reported for NASA space exploration programs. Discussions are presented for technical supporting activities, engineering development of environmental test facilities, and quality assurance and reliability. Considered are the Surveyor, Mariner, and Voyager projects; deep space network systems; and a deep space instrumentation facility. C.T.C.

N66-19632*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EPHEMERIDES OF THE EARTH–MOON BARYCENTER VENUS, MARS, AND MERCURY CONSIDERING THE EARTH AND MOON AS SEPARATE BODIES
C. J. Devine and D. W. Dunham 1 Mar. 1966 59 p refs
(Contract NAS7-100)
(NASA-CR-71209; JPL-TM-33-232) CFSTI: HC $3.00/MF $0.50 CSCL 03C

The differential equations for the motions of the Earth–Moon barycenter considering the Earth and Moon as separate bodies are discussed. The ephemerides of the Earth–Moon barycenter, Venus, Mars, and Mercury constructed with these differential equations are compared with the ephemerides of the same planets constructed with differential equations in which the Earth and Moon are considered as a point mass located at the barycenter of the Earth–Moon system. Position residuals and angle residuals between the two systems are plotted. Author

N66-19636*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
PHYSICS OF PLANETARY ATMOSPHERES. IV: GAS ANALYSIS BY PHOTOIONIZATION MASS SPECTROMETRY
W. Poschenrieder and P. Warneck Jan. 1966 34 p refs Submitted for Publication
(Contracts NASw-1283; AF 19(628)-3849)
(NASA-CR-71210; GCA-TR-66-1-N) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A photoionization mass spectrometer featuring a special 180-degree magnetic analyzer with inclined pole faces is described and its usefulness as a gas analytical tool is explored. The investigated range of ion source pressures was 0 to 150 microns. It was found that pressures up to 20 microns can be utilized for gas analysis. At higher pressures, ion-molecule reactions and increasing light absorption cause nonlinear ion current-pressure relationship. The major advantage of photoionization when compared to electron impact ionization is the simplicity of fragmentation patterns, the major disadvantage, the lower sensitivity. At 20 microns pressure, spark or resonance light sources used in conjunction with a 1/2-meter monochromator produced peak ion intensities around 5×10^{-13} Å. Although these ion intensities are higher than those reported previously, they are still considerably below the ion intensities commonly produced by electron impact ion sources. Author

N66-19645*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ATMOSPHERIC DENSITIES AND TEMPERATURES FROM PRECISELY REDUCED OBSERVATIONS OF THE EXPLORER IX SATELLITE
Mas Roemer 3 Feb. 1966 90 p refs
(Grant NsG-87-60)
(NASA-CR-71191; SAO Special Rept.–199) CFSTI: HC $3.00/MF $0.75 CSCL 22A

The atmospheric drag of the Explorer IX satellite through May 1963 was derived using precisely reduced photographs taken with the Baker-Nunn cameras. The accuracy of an individual acceleration was determined to be ±5%. Analysis of the atmospheric density data revealed a latitude-dependent seasonal density variation of ±25% at a latitude of 39° and an average height of 690 km. The atmospheric density at a given height is higher in winter than in summer. The statistics of 100 atmospheric variations related to geomagnetic storms give 5.2±0.4 hours as the average time lag between the maximum of a geomagnetic storm and the peak in atmospheric density. The influence of the variation of the drag coefficient with atmospheric composition on the absolute density values is discussed. Author

N66-19648*# Bellcomm, Inc., Washington, D. C.
PHOTOMETRY AND POLARIMETRY OF THE MOON AND THEIR RELATIONSHIP TO PHYSICAL PROPERTIES OF THE LUNAR SURFACE
C. A. Pearse 23 Aug. 1963 91 p refs
(NASA-CR-70713) CFSTI: HC $3.00/MF $0.75 CSCL 03B

A review is given of experimental and theoretical information relating to the photometry of the moon. An attempt is made to display the salient lunar light reflecting properties which are controlled by the exact nature of the lunar surface microrelief. A brief discussion is presented of a model of the

lunar surface covering layer, and this model is compared with the conclusions necessitated by photometric data. A listing is made of factors excluded from the study, and conclusions and recommendations are given. C.T.C.

N66-19676# Yale Univ., New Haven, Conn.
SEARCH FOR PLANETARY OPTICAL EMISSION, AND STUDY OF FLARE ACTIVITY OF NEARBY STARS Final Report
Harlan J. Smith 3 Dec. 1965 6 p refs
(Grant Nonr(G)-00043-62)
(AD-624895) CFSTI: HC $1.00/MF $0.50

Jovian decameter radio noise storms arise from particles emitting essentially at gyrofrequencies near the Jovian magnetic poles. Parallel microwave radio studies indicate that Jupiter possesses very strong radiation belts. Results suggest that clouds of ions focusing into Jupiter's magnetic poles should also produce strong auroral activity. Detection of such auroras would provide a valuable test of the radio theories, would give information on Jupiter's ionosphere, and would permit a direct mapping of the near-surface magnetic field configurations of the planet. Observational work is reported; however, results have been inconclusive and equipment is required which is much more sophisticated than that available. E.E.B.

N66-19677# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL, CORRELATION, AND SPECTRAL FUNCTIONS OF INTERSTELLAR GAS TURBULENCE
S. A. Kaplan 19 Nov. 1965 17 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 32, no. 3, May–Jun. 1955 p 255–264
(FTD-TT-65-09; AD-624914) CFSTI: HC $1.00/MF $0.50

Structural, correlation, and spectral functions of interstellar medium turbulence are calculated on the basis of Adams' catalog of radial velocities of interstellar gas clouds. Results of these calculations show that motion of interstellar medium is described fully satisfactorily by the theory of isotropic and homogeneous turbulence. Structural, correlation, and spectral functions are shown. Discussion is given of the possibility of describing turbulence of the interstellar medium with the help of the contemporary theory of turbulence. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-18847*# Planning Research Corp., Washington, D. C.
RELIABILITY ASSESSMENT OF THE GEOS A SPACECRAFT
29 Dec. 1965 46 p refs
(Contract NASw-1180)
(NASA-CR-70824; PRC-R-760) CFSTI: HC $2.00/MF $0.50 CSCL 22B

This report provides a summary of the GEOS A subsystem reliability assessments as well as the overall system assessment. In addition a reliability improvement study on the GEOS A clock and memory subsystem is discussed. Assuming that the Doppler and transponder experiments have a reliability of one, the effectiveness figure-of-merit for the GEOS A spacecraft lies between 0.41 and 0.63. The lower limit corresponds to a zero value for the alternate optical logic, and the upper limit corresponds to a value of the alternate optical logic equal to the value of the memory controlled logic. It is recommended that certain studies associated with command and telemetry channel assignments, complete review of the parts program, and improvement of the clock and memory design be carried out. A modification to the design of the optical beacon is also recommended. Author

N66-18855# Space/Defense Corp., Birmington, Mich.
[PROJECT WEBROCK] Semiannual Status Report, 15 Jun.–15 Dec. 1965
Michael Brian 22 Dec. 1965 7 p
(Contract Nonr-5013(00))
(AD-625873)

The feasibility of launching meteorological rockets from remote weather buoys to acquire ocean upper air data is being studied. A test system was designed, fabricated, and tested; and preliminary field experiments were conducted. Based on availability, reliability, and ease of handling, the 2.75 in. FFAR rocket was selected for use. A prototype buoy was designed and built, and is described along with its electronic attitude sensing system for rocket firing control. D.T.

N66-19043*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS Quarterly Progress Report, 15 Sep.–31 Dec. 1965
J. Y. S. Luh [1965] 79 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-70482) CFSTI: HC $3.00/MF $0.75 CSCL 22C

In connection with the soft landing problem, an optimal control problem in phase-coordinate and bounded control processes was studied. The general theory for a linear autonomous system was developed and used to determine a method of optimal control. This was done by deriving an algorithm for expressing the open-loop control law as a time function. The method was applied to the time-optical control of an unstable booster with actuator position and rate limits. The control problem of antenna pointing was also investigated as a stochastic optimal control problem in which the probability that the antenna pointing at the desired direction is maximized. The transition density of the stochastic control process was computed, and the pursuit problem of Mishchenko and Pontryagin is summarized as part of the solution. A preliminary result is that if the z-process is Markov, then it is also a process with independent increments and the n-process is white noise. E.A.O.

N66-19105*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DAMPING AND OSCILLATORY STABILITY IN PITCH AND YAW OF GEMINI CONFIGURATION AT MACH NUMBERS FROM 0.50 TO 4.63
Bruce R. Wright and Robert A. Kilgore Washington, NASA, Mar. 1966 73 p refs
(NASA-TN-D-3334) CFSTI: HC $1.05/MF $0.75 CSCL 22B

Wind tunnel measurements of aerodynamic damping and oscillatory stability in pitch and yaw for scale models of proposed Gemini abort and reentry configurations were made at

Mach numbers from 0.50 to 4.63 using a 2° amplitude forced oscillation mechanism. Damping and oscillatory-stability parameters in pitch were obtained at mean angles of attack in the range of ±45° from 0° and ±45° from 180° with models at an angle of sideslip of 0°. Damping and oscillatory-stability parameters in yaw were determined at mean angles of sideslip near 0° and 180° with models at an angle of attack of 0°. Tests were made to determine the effect of canting the front face of the antenna housing 18°. Both abort and reentry configurations with the antenna housing forward exhibit positive or near zero damping in pitch for all Mach numbers, but the abort configuration exhibits negative damping at higher mean angles of attack for low Mach numbers. Canting the antenna housing face to 18° has little effect on damping for the abort or reentry configurations with the antenna housing forward. Both configurations with the antenna housing rearward exhibit negative or zero damping in pitch over a varying range of mean angle of attack near 180°. R.N.A.

N66-19186*# Southwest Center for Advanced Studies, Dallas, Tex.
COMPARISON OF ROCKET-BORNE PROBES FOR ELECTRON DENSITY MEASUREMENTS Quarterly Status Report No. 5, Aug. 1- Oct. 31, 1965
J. A. Fejer, W. J. Heikkila, and O. Holt [1965] 16 p
(Contract NSR-44-004-017)
(NASA-CR-70858) CFSTI: HC $1.00/MF $0.50 CSCL 22D

Studies were initiated to evaluate and compare different ionospheric probe techniques. Each rocket payload, called a multiple ionospheric probe, included five types of probes for electron density measurements: the resonance relaxation probe, the variable frequency impedance probe, the resonance rectification probe, a capacitance probe, and a combination of the electrostatic and Langmuir probes. The experiments were programmed to operate on a time-shared basis to avoid mutual interference. Preliminary data from the resonance relaxation probe showed several resonances at expected frequencies. Signals from the variable frequency impedance and resonance rectification probes were recorded, and the signal was found to be reduced considerably at several distinct frequencies in the ionosphere. With the high frequency capacitance probe, measurements of ion current and high frequency capacitance were obtained to permit a quantitative test of electrostatic probe theory. N.E.N.

N66-19446*# General Dynamics/Convair, San Diego, Calif.
ATLAS/CENTAUR FLIGHT PERFORMANCE RESERVE MONTE CARLO ANALYSIS AC-7
J. F Ingber 17 Sep. 1965 55 p refs
(Contract NAS3-3232)
(NASA-CR-54139; GD/C-BTD65-143) CFSTI: HC $3.00/MF $0.50 CSCL 22D

This report first discusses a Monte Carlo method which has been developed for the computation of Flight Performance Reserve (FPR) requirements for a Booster X/Centaur configuration. Second, the results of an application of the model to the Atlas/Centaur AC-7 configuration are presented. Toward the end of this study, an operating characteristic of the Centaur Propellant Utilization (PU) System known as "PU End Effect" was identified. Since, however, a significant amount of effort had been expended prior to the identification of this characteristic, and since it is likely that "PU End Effect" logic will be modified, it was deemed desirable to publish the report proper without "PU End Effect" and to include an appendix treating this subject separately. At the time this study was initiated, the major unknown variable of the problem was PU system accuracy. Thus the results are presented parametrically as a function of this variable. Present PU control system error analysis indicates a system uncertainty of approximately ±25 pounds equivalent LH_2. Results for this condition are summarized below for direct ascent Surveyor missions. Note the 30 pound loss in payload capability due to PU System "End Effect." Author

N66-19464*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ANALYTICAL INVESTIGATION OF THE MOTION OF A CLAMSHELL-TYPE HEAT SHIELD ON DEPLOYMENT FROM A PARENT VEHICLE IN THE ATMOSPHERE
Ross L. Goble Washington, NASA, Mar. 1966 51 p refs
(NASA-TN-D-3280) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The equations of motion for the deployment of the clamshell-type heat shield are developed herein for the various phases of separation from an accelerating vehicle in the sensible atmosphere. The shield motion is planar and is divided into four phases: Phase 1, translation from the closed position to pivot contact; phase 2, rotation about pivot; phase 3, translation on and rotation about pivot to release; and phase 4, translation and rotation away from the parent vehicle. Closed-form solution of the linear equation of motion in phase 1 for constant lift and drag permits description of the translation velocity. An iterative numerical integration technique is used to solve the velocity. An iterative numerical integration technique is used to solve the nonlinear equations of angular motion for phases 2, 3, and 4. The release equation is also established. Specific applications of the analysis to deployment of the Nimbus heat-shield configurations, used on many NASA projects, under various vehicular acceleration and aerodynamic loading conditions are included. Author

N66-19479*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
NIKE TOMAHAWK PRELIMINARY PERFORMANCE STUDIES
Edward E. Mayo Feb. 1966 136 p
(NASA-TM-X-55423; X-721-66-77) CFSTI: HC $4.00/MF $1.00 CSCL 16D

In-house studies concerning the performance of the Nike Tomahawk are compiled. The following areas are investigated: (1) Nike Tomahawk particle trajectory characteristics; (2) effect of payload weight on the Tomahawk mass, static margin, static stability, and natural frequency characteristics; (3) Tomahawk dynamic motions; and (4) aerodynamic running load distribution over the Tomahawk body. The predictions should be updated as the vehicle properties and aerodynamic characteristics are refined. Author

N66-19483*# General Dynamics/Astronautics, San Diego, Calif.
EFFECT OF PITCH PROGRAM VARIATIONS ON LAUNCH AVAILABLILITY OF ATLAS/CENTAUR-AC-7 TO AC-15
T. E. Johnson 28 Dec. 1964 53 p refs
(Contract NAS3-3232)
(NASA-CR-54541; GD/A-DDE64-045) CFSTI: HC $3.00/MF $0.50 CSCL 22D

Six initial pitch programs were generated by iterating the Atlas/Centaur trajectories to meet simultaneously payload, thermodynamic, aerodynamic, and inertia load constraints for launch during any season of the year. Each pitch program was selected to produce approximately zero angle-of-attack through one of six average wind profiles. A comparison was made of the six pitch programs for launch availability for each month of the year. It was found that only three programs are needed, giving a launch availability high of 100% in July and a low of 10% in February, March, and December. The effect on launch availability of increasing the Atlas LO_2 tank minimum pressure from 28.5 psig to 33.5 psig at 20 seconds of flight

and by increasing the Centaur LH_2 tank minimum pressure from 19.5 psig to 22.0 psig at liftoff were considered. It was found that this increase can improve the launch availability by as much as 20%. Also considered is a reduction in the gust velocity criterion from 40 ft/sec to 30 ft/sec, which produces a launch availability increase of 23% in the worst winter months. N.E.N.

N66-19484*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF A CHANGE IN ORIENTATION OF A RECTANGULAR FOUR-PADDLE SOLAR ARRAY ON THE SPIN RATE OF A SATELLITE
S. G. Mc Carron Jan. 1966 37 p
(NASA-TM-X-55422; X-716-66-71) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Two cases of spin-rate dependence of a four-paddle satellite are analyzed: (1) the case where the spin rate changes by varying the paddle-spar angle, holding the paddle-pitch angle constant, and (2) the case where the spin rate changes by varying the paddle-pitch angle, holding the paddle-spar angle constant. In both cases it is assumed that component mass homogeneity exists, the same variation in paddle-pitch or paddle-spar angles occurs simultaneously on all four solar paddles, and external torques (aerodynamic, solar radiation, etc.) are negligible over a short period of time. Conditions are discussed for satellite normalized-spin-rate decay or growth based solely on solar-array geometry. In the appendices are curves of the solar-paddle moment of inertia, paddle-arm moment of inertia, and satellite normalized-spin rates, as a function of orientation for the laboratory model satellite, as well as, for a full scale IMP-type satellite. Author

N66-19500# Martin Co., Denver, Colo.
PROGRAM 624A DESIGN LOADS REPORT, CONFIGURATION A, FORMAL ISSUE
K. Kopp and R. Morra Apr. 1964 228 p refs
(Contract AF 04(695)-150)
(SSD-CR-64-36; AD-349161) (Declassified)

This report presents a compilation of all significant flight and ground loads that are anticipated for the 624A Configuration A flight vehicle. The applicable configurations consist of the 624A core and standard nose fairing with dummy payload weights of 800, 1,500, or 5,000 lb. Flight loads are presented for all portions of the flight regime, starting from shortly after launch when all transients have damped out, through, and including, stages I, II, and III flights. Ground loading conditions are generally defined by specification requirements. For this reason, information in such typical form as load vs Mach number and wind azimuth, etc., has been provided in detail, to show that the conditions of maximum load have been properly defined. Maximum combined loading is presented in the greatest detail. In addition, the individual components of loading from the various sources such as basic flight trajectory loads, dispersed loads, gust loads, and buffet loads are also presented in detail under separate headings. Author

N66-19511*# General Dynamics/Convair, San Diego, Calif.
GROUND-WIND RESTRICTIONS PROCEDURE FOR ATLAS/CENTAUR/SURVEYOR AC-6 AND AC-7
M. I. Kestenbaum 1 Jun. 1965 46 p refs
(Contract NAS3-3232)
(NASA-CR-54331; GD/C-BTD65-061) CFSTI: HC $2.00/MF $0.50 CSCL 22D

This report contains ground-wind restrictions and associated information for the Atlas/Centaur/Surveyor, vehicles AC-6 and AC-7, at the Eastern Test Range while erected on the launcher pad. Limiting wind speeds for the Atlas/Centaur vehicle while on automatic pressure regulation, both freestanding and with tower in place, are presented in tabular form for normal launch sequence tanking conditions. For certain wind directions there are limiting wind speeds based on launcher capability. Recommended courses of action are contained in the event that wind speeds and/or vehicle pitch and yaw rate gyro responses exceed the specified allowable values during normal sequence tanking. Maximum allowable recorded wind speeds and rate gyro responses for other possible tanking conditions are presented in graphical form for Atlas Step I, II, and III pressures. The introduction of the wind direction and structural capability as controlling parameters is explained and illustrated. Author

N66-19529*# ARACON Geophysics Co., Concord, Mass.
TIROS VIII ATTITUDE SUMMARY (ORBITS 4000-8938), VOLUME II Fourth Technical Summary Report, 22 Sep. 1964–29 Aug. 1965
Adrienne Zenuk Dec. 1965 222 p refs *Its* Rept.-9620-10
(Contract NAS5-9547)
(NASA-CR-71082) CFSTI: HC $6.00/MF $1.25 CSCL 22B

This report presents operational definitive and predictive attitude data on TIROS VIII spin axis camera orientation for orbits 4000 to 8938 covering the period 22 September 1964 to 29 August 1965. Attitude determinations were made at data acquisition stations and compiled daily in the form of an operation definitive attitude message (ODAM) for teletype transmission to the various consumers. These daily ODAM transmissions are summarized in graphical and tabular form. R.N.A.

N66-19542*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS SPACECRAFT MAGNETIC CONTAMINATION Status Report
J. G. Bastow 1 Feb. 1966 30 p
(Contract NAS7-100)
(NASA-CR-71101; JPL-TM-33-261) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Magnetic mapping results of more than 1900 items of the Mariner Mars spacecraft are tabulated. Author

N66-19584*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
VOYAGER PROJECT Progress Report, Nov. 16–Dec. 15, 1965
1 Jan. 1966 48 p refs
(NASA-CR-70706; VPPR-11) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Mission objectives and plans for the Voyager project are presented. A technical description of the planetary vehicles to be used and, the sequence of events for project implementation are included. Development of the spacecraft, capsule, and mission operations systems are discussed. Included are tables and charts depicting project organization, schedules, test status summary, manpower needs, financial activity, and cumulative obligations and commitments. H.S.W.

N66-19616*# Radiation Applications, Inc., Long Island City, N. Y.
DEVELOPMENT OF A PROTOTYPE PLASTIC SPACE ERECTABLE SATELLITE Quarterly Report, Sep.–Nov. 1965
Richard Everett, Jr. and Preston Keusch 17 Jan. 1966 38 p
(Contract NAS5-3923)
(NASA-CR-70929; RAI-360) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The mesh for the cap section fabrication was irradiated to 15 Mrads and heat treated for two hours at 140° C in a nitrogen atmosphere. It was then electrolessly plated and cut into the proper subsegment dimensions in preparation for ultrasonic bonding. A testing program was devised for all phases of the fabrication scheme, including a flexural rigidity testing method. There was little change in the tensile strength of the mesh after irradiation, and it became less elastic than the unirradiated material. Additionally, the material showed an approximate increase of 25% in flexural rigidity. H.S.W.

N66-19628*# TRW Systems, Redondo Beach, Calif.
ADVANCED PLANETARY PROBE STUDY Mid-Term Technical Progress Report
15 Mar. 1966 175 p refs Prepared For JPL
(Contracts NAS7-100; JPL-951311)
(NASA-CR-71207) CFSTI: HC $5.00/MF $1.00 CSCL 22B

This study applies to space missions to be conducted during the period 1970 to 1980. Because of substantial transit times for missions to the more distant planets, the end of the mission, as determined by the arrival time, could be as much as eight years later. It is indicated that since a reasonable lead time is necessary so that the subsystem design is established sufficiently in advance of the launch date, the earliest launches in this time period must be accomplished with hardware which essentially reflects the 1966 state-of-the-art. The later launches may reasonably be based on developments in technology expected to occur at appropriately later times. The probe is directed towards: (1) basic flyby missions of the planets Jupiter, Saturn, and Neptune; and (2) examination of the growth potential of the basic concepts through the use of a modular design concept to perform orbiter and planetary capsule entry missions. The experimental objectives of the probe include: measurement of the spatial distribution of interplanetary and planetary particles and fields; measurement of the salient features of planetary atmospheres, with particular emphasis on remote measurements from a flyby spacecraft; and observations of the planets, i.e., visual and infrared. Also discussed are spacecraft configuration constraints, the six launch vehicle combinations, and the dominating characteristics of the extension of interplanetary and planetary missions to the outer planets of the solar system. R.R.D.

N66-19643*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OBSERVATION OF GEMINI 6–GEMINI 7 RENDEZVOUS
James H. Latimer 21 Feb. 1966 12 p
(Grant NsG-87-60)
(NASA-CR-71200; SAO Special Rept.–202) CFSTI: HC $1.00/MF $0.50 CSCL 22B

On December 16, 1965, the Smithsonian Astrophysical Observing Station at Villa Dolores, Argentina, successfully photographed the Gemini 6 and Gemini 7 manned spacecraft together. This report contains the observational data. Author

N66-19663*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
NASA SUNBLAZER Sixth Progress Report, Oct. 1–Dec. 31, 1965
J. V. Harrington [1965] 13 p
(Contract NASr-249)
(NASA-CR-70730; CSR-PR-5255-7) CFSTI: HC $1.00/MF $0.50 CSCL 22B

It is reported that work has continued on the spacecraft mechanical, thermal, and orientation design and electronic packaging. In addition, vibration, shock, and acceleration testing specifications were written. Also reported is that a change in the onboard transmitter frequencies to those compatible with the El Campo solar array has resulted in a substantial amount of transmitter redesign. C.T.C.

N66-19669# University Coll., London (England). Dept. of Physics.
REPORT ON A SPACECRAFT FOR MAGNETOSPHERIC STUDIES
A. P. Willmore Paris, ESRO, Nov. 1965 29 p
(ESRO-SM-4) CFSTI: HC $2.00/MF $0.50

This report embodies some possible specifications of a medium size spacecraft for magnetospheric studies. After reviewing the various possible experiments (study of the magnetosphere, study of the magnetopause, ionospheric irregularities and airglow enhancements, processes occurring in ionospheric and magnetic storms), a set of typical requirements (stabilization, power, weight, data storage, etc.) are given, as well as a comparison with the OGO series of NASA. The results of a R.A.E. design study for a small stabilized satellite are then used to obtain some estimate of the weight and the size of the resulting spacecraft. Author

N66-19688*# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Astronautics Div.
STUDY TO DETERMINE THE EFFECTS ON THE SCOUT VEHICLE STRUCTURE DUE TO UNCONVENTIONAL VEHICLE-SPACECRAFT CONFIGURATIONS
20 Nov. 1964 306 p refs *Its* Rept.-23.175
(Contract NAS1-3899; Proj. Scout)
(NASA-CR-66075) CFSTI: HC $7.00/MF $1.75 CSCL 22B

A Scout vehicle composed of the following motor stack was used for this study: (1) first stage, Algol IIB; (2) second stage, Castor II; and (3) third stage, ABL X-259. The two basic vehicle configurations investigated were: Case I-A—a 300-pound conical reentry payload mounted in a current 34-inch diameter—25 station heat shield; and Case II-A—a 150-inch length 5° half angle conical payload which weighs 300, 400, 500, and 600 pounds. A detailed description of the payloads, weights, weight distribution, stiffness, and center of gravity locations is presented. It was concluded that payloads representing an unconventional vehicle-spacecraft configuration can be flown on the Scout vehicle with only small changes made to the present Scout production hardware. R.R.D.

N66-19710*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER 1964 PROBABILITY OF SUCCESS MODEL
J. M. Billy and R. G. Chamberlain 2 Nov. 1964 46 p refs *Its* Proj. Doc. No. 27
(Contract NAS7-100)
(NASA-CR-71252) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The purpose of this report is to describe a mathematical model which evolved out of the effort to determine the probability of obtaining various combinations of the Mariner 1964 mission objectives. The model assumes that the mission and spacecraft can be divided into independent, functional blocks whose series and parallel combination comprise the totality of the mission. Various parameters, which define the independent functional blocks stochastically, are then introduced and the results are presented as functions of these parameters. Specific values for these parameters are chosen and results are derived and discussed. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-18499# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE RESPONSE OF A BEAM TO AN IMPACT LOADING

Thomas Jerome Higgins, III (M.S. Thesis) Jun. 1965 65 p refs (GAW/MECH/65-27; AD-625441) CFSTI: HC $3.00/MF $0.75

The thesis discusses several theories which have been used to describe the response of a beam to an impact loading. Several of these theories were developed for steady state applications but have been used to estimate the response due to an impact loading. The response of the beam is divided into three phases and the conclusion is reached that each phase of the response is best described by a different theory. Author (TAB)

N66-18527# United Research Services, Burlingame, Calif.

EFFECTS OF STRUCTURAL COMPRESSIBILITY ON ACTIVE AND PASSIVE ARCHING IN SOIL-STRUCTURE INTERACTION Final Report

Harold G. Mason Nov. 1965 159 p refs (Contract DA-49-146-XZ-288) (URS-645-8; DASA-1718; AD-625732) CFSTI: HC $5.00/MF $1.00

The basic theory of static active and passive arching is reviewed, and theoretical relationships describing the effect that structural geometry (length to span) has on the load on the structure, are developed. Equations are developed for passive and active arching for deeply buried idealized compressible cylindrical structures vertically oriented. Linear and nonlinear soil conditions are investigated. Equations are also derived to predict the load (on a trap door) resulting from differential strains occurring between the trap door and the bottom of the soil bin in the deeply buried condition. Both active and passive arching cases and linear and nonlinear soil conditions are considered. A limited experimental program was conducted to investigate the effects of the ratio of the soil to structural compressibility on the load on the structure. Good correlations are shown between the results of this study and the theoretical predictions employing soil parameters measured in normal laboratory soil tests. Similar correlations are also shown between the results of a trap door experimental study and the theoretical predictions. The relationship between rate of loading and the rate of structural response was shown to be a controlling factor in determining whether the loading or unloading stress-strain relationship governs the arching behavior. Author (TAB)

N66-18528# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

AN EXPERIMENTAL STUDY OF THE CREEP BUCKLING OF CIRCULAR CYLINDRICAL SHELLS UNDER AN AXIALLY APPLIED COMPRESSION Technical Report No. 16

R. Carlson, B. Schneider, and L. Berke Oct. 1965 48 p refs (Contracts Nonr-225(30); Nonr-224(47)) (SUDAER-248; AD-625716) CFSTI: HC $2.00/MF $0.50

The use of electroforming to produce circular cylindrical shells is described. Examples are cited for which the use of electroforming provides opportunities for the development of unique specimen designs and test procedures. The use of a tapered creep specimen to generate isochronous stress-strain curves is described. The procedure developed provides a method for deriving basic creep relationships form data obtained from a small number of tests. The results of creep buckling tests on circular cylindrical shells under axial compression are presented. The basic features described are the end-shortening history, the variation of buckling load with time, and the post-buckling pattern which is developed. Author (TAB)

N66-18537# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE SOLUTION OF THE PROBLEM OF BENDING OF A SHALLOW SPHERICAL SHELL WEAKENED BY AN APERTURE

N. Kh. Suyunshkaliyev 3 Dec. 1965 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 3, 1964 p 43–53 (FTD-TT-65-1076/1+4; AD-625152) CFSTI: HC $1.00/MF $0.50

Equations are derived which reduce the problem of the bending of a shallow spherical elastic shell weakened by an aperture to certain boundary value problems of the theory of functions of a complex variable. The four unknown functions are defined in terms of two boundary conditions on the contour of the aperture and from the condition of regularity at infinity. It is noted that by combining these equations solutions may be obtained for all the practical cases of attachment and loading of the contour of a shell aperture. E.A.O.

N66-18544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF EXTRUSION ELEMENTS DURING THE CONSTRUCTION OF SHIPS ON SUBMARINE WINGS (HYDROFOILS)

B. V. Chubikov 20 Dec. 1965 17 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 3, 1965 p 26–30 (FTD-TT-65-1883/1+2+4; AD-625806) CFSTI: HC $1.00/MF $0.50

Aluminum alloy extrusions in the form of pressed profiles and panels for hydrofoil ship construction are discussed. Various types of profiles are described and permissible geometric ratios are tabulated. Emphasis is placed on pressed panels which represent a monolithic structure of sheet and profiles. Preparation, bending characteristics, and welding possibilities are presented. Advantages of pressed panel construction include use in double surface curvature, increased carrying ability and decreased weight, decreased welding volume and deformations, and decreased ship construction time. E.A.O.

N66-18545# Bureau of Ships, Washington, D. C.

STRESSED STATE AROUND A CIRCULAR HOLE IN A SHELL OF REVOLUTION WITH A SHALLOW MERIDIAN ARC [O NAPRIAZHENNOM SOSTOIANII OKOLO KRUGOVOGO OTVERSTIIA V OBOLOCHKE VRASHENIIA S POLOGOI MERIDIONAL'NOI DUGOI]

A. N. Guz Oct. 1965 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk.: Mekhan. i Mashinostr. (Moscow), no. 3, 1964 p 142–144 *Its* Transl. No. 943 (AD-625076) CFSTI: HC $1.00/MF $0.50

The equilibrium of a shell of revolution with a very shallow meridian arc, weakened by a central hole with the center in the peak of the meridian arc, is considered. The stressed state of

such a shell consists of the basic state without the hole, and of a supplemental state rapidly attenuating with the distance from the hole. The shell is related to a system of coordinates, with the origin in the center of the hole. The stressed state is described by the equations of the theory of double curvature shallow shells. Equations are derived for the particular cases of the basic stressed state, including torsion, uniaxial elongation, and uniform internal pressure. E.A.O.

N66-18568# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ULTRASONIC DEFECTOSCOPY OF TUBES

E. Ya. Versler and V. P. Krivusha 18 Oct. 1965 7 p ref Transl. into ENGLISH from Energetika (Kharkov), no. 1, 1963 p 10–11 (FTD-TT-65-740/1+2+4; AD-625229) CFSTI: HC $1.00/MF $0.50

An ultrasonic defectoscope on a frequency of 2.5 MC was developed for nondestructive testing of crack formation in tubes used in power plants. Upon examination, it was found that the defective tubes identified by this device were those for which corrosion had just begun and for which no visible signs of crack formation existed. Without this device, it is not possible to expose such cracks prior to tube destruction because the microstructure of the metal and the external diameter of the tube does not change with the development of corrosion fatigue. M.W.R.

N66-18577# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

SUPERSONIC WIND TUNNEL TESTS OF WAVY-WALLED CYLINDERS Final Report, Feb.–Apr. 1964

William J. Anderson Oct. 1965 64 p refs (ARL-65-203; AD-626932) CFSTI: HC $3.00/MF $0.75

The primary objective of the experiment was to provide pressure measurements for use in flutter calculations. Wavy-walled cylinders were wind tunnel tested at Mach 3.0 and 4.62. The walls of the cylinders were rigid, with a sinusoidal deflection pattern machined in the outer surface. The waves extended in both the axial and circumferential direction. Flow was directed along the cylinder axis. Static pressures were measured at the wavy surface of each cylinder. The pressure perturbations proved to be smaller in amplitude than predicted by inviscid aerodynamic theories. The pressure distribution also had a small phase shift downstream. The tests are helpful in studying viscous flow effects on the pressures. A direct comparison with an existing idealized boundary layer theory was impossible, however, because of the choice of wave height on the model. Boundary layer separation occurred under some conditions. Separation was observed in the form of a small bubble lying behind a wave, particularly in regions where the boundary layer was laminar. Oil film studies were made by using a thin film of oil on the surface. When exposed to ultraviolet light, the oil film fluoresced, revealing the stream line pattern. Photographs of the oil film patterns and a number of Schlieren pictures are presented. Author (TAB)

N66-18581# Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.

STIFFNESS DESCRIBER OF A FILAMENT WOUND CYLINDER FOR DYNAMIC ANALYSES

Jacob M. Miller Dec. 1965 48 p refs (Contract AF 49(638)-1509) (AFOSR-65-2214; AD-626226) CFSTI: HC $2.00/MF $0.50

This report presents a technique for assembling a Stiffness Describer for Filament-Wound Cylinders (FWC) in the form of a Stiffness Matrix. The technique described provides the dynamicist with the means to analyze FWC. The data that would be required are physical properties such as: Poisson's Ratio, Moduli of Elasticity and Rigidity for the filament and resin, winding angles of plies, geometric data such as cylinder length, radius, overall thickness. The technique described produces a method for representing FWC analogous to that developed for beam-plate complex structures. The derivation of the Stiffness Describer of a FWC entails: writing the load-deflection equations for a shell in matrix form, applying boundary conditions for axial lengths (for assembly purposes), and mathematical modeling of FWC in terms of physical material constants. The expressions used to define structural relationships arose from strain energy considerations for shells and for plies at various angles to the cylinder's axis. The mathematical modeling was based on load paths that occur in composite materials. Author (TAB)

N66-18591# Massachusetts Inst. of Tech., Cambridge.

THEORETICAL-EXPERIMENTAL CORRELATION OF LARGE DYNAMIC AND PERMANENT DEFORMATIONS OF IMPULSIVELY-LOADED UNBONDED CONCENTRIC RINGS Final Report

Hans A. Balmer and Emmett A. Witmer Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Nov. 1965 82 p refs (Contract AF 33(615)-1943) (ASRL-TR-128-4; AFFDL-TR-65-143; AD-626591) CFSTI: HC $3.00/MF $0.75

A numerical method previously described for predicting large dynamic and permanent deformations of two-dimensional structures of elastic-plastic material was extended to analyze explosively-loaded unbonded concentric rings. This extension was employed to carry out comparisons between predicted and measured dynamic responses and permanent deformations of explosively-loaded unbonded concentric 6061-T6 rings. Good agreement between theory and experiment was found. Author (TAB)

N66-18613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OSCILLATIONS AND STABILITY OF A TRIPLE LAYER CYLINDRICAL SHELL WITH INCOMPRESSIBLE IDEAL LIQUID

V. V. Stepanyuk 15 Dec. 1965 15 p refs Transl. into ENGLISH from Prik. Mekhanika (Moscow), v. 1, no. 2, 1965 p 78–85 (FTD-TT-65-1252/1+2+4; AD-625297) CFSTI: HC $1.00/MF $0.50

A discussion is given of oscillations of a compound cylindrical shell of finite length, consisting of two isotropic coaxially smooth shells, rigidly soldered together by the generatrixes in contact points, with the coaxially corrugated shell situated between them. Along the pipes, formed by one of the external shells and the corrugated wave, flows an ideal incompressible liquid. The purpose of the report is the determination of the effect of liquid flow on shell oscillations. TAB

N66-18665# Lockheed Missiles and Space Co., Palo Alto, Calif.

THE PREFERRED MODE SHAPE IN LINEAR BUCKLING ANALYSIS OF CIRCULAR CYLINDRICAL SHELLS UNDER UNIFORM AXIAL COMPRESSION

P. Mann-Nachbar and W. Nachbar (Stanford Univ.) May 1964 48 p refs (LMSC-6-90-63-115; AD-625838) CFSTI: HC $2.00/MF $0.50

The chessboard buckle pattern in the solution of the linearized Donnell equations for buckling of a thin, cylindrical shell under axial compression is so sensitive to uncertainties in shell dimensions that the number of circumferential waves and the aspect ratio of the buckles is indeterminate. This problem is treated statistically. Shell dimensions are treated as random variables with probability distributions dependent on nominal values and manufacturing tolerances. Distributions for aspect ratio and number of circumferential waves are found by a Monte-Carlo technique. It is found that the linear theory does contain a mechanism for distinguishing among buckle shapes; there is always a preferred buckle shape. For thin shells and attainable manufacturing tolerances, the aspect ratio of the preferred shape is near one, and the corresponding number of buckles is large. Author (TAB)

N66-18681# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ALGORITHM OF THE CONSTRUCTION OF ASYMPTOTIC APPROXIMATIONS OF SOLUTIONS FOR SOME MIXED BOUNDARY VALUE PROBLEMS AND BOUNDARY VALUE PROBLEMS WITH NONLINEAR BOUNDARY CONDITIONS

B. I. Moseenkov [1964] 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 11, 1965 p 1410–1413

Single frequency vibrations of elastic vibratory systems were studied by forming a construction algorithm for asymptotic solutions. Considered were one-dimensional mixed boundary value problems as well as boundary value problems with nonlinear boundary conditions. Single-frequency oscillations of the unperturbed and the perturbed system in the first dynamic equilibrium mode were evaluated by asymptotic expansion through successive determination of their coefficients in Fourier series. G.G.

N66-18747# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

VIBRATION ISOLATION THROUGH PNEUMATIC SPRING AND DAMPING

Russel L. Hall [1965] 24 p refs Presented at the 35th Symp. on Shock and Vibration, New Orleans, 11 Oct. 1965

(Contract AT(29-1)-1183)

(CONF-651016-1) CFSTI: HC $1.00/MF $0.50

The passive isolation of harmful shock and vibrations as applied to a relatively large package containing fragile data acquisition equipment is discussed. The shock isolator was comprised of a lightweight cylinder containing compressed air and a piston which is fully extended at steady state. The air cylinder isolator functions as zero deflection support, spring and damper. The package resembles a large commercial trailer. The trailer package was designed to be temporarily located at ground level in areas subjected to severe jolting earth movements. Efficient isolation through air spring damper appeared to require that the nonlinearities associated with the air spring offset the nonlinearities associated with the air damper. Linear nodal force balance equations were written, describing one degree of freedom, lumping all vibration control into one isolator. NSA

N66-18760# Sandia Corp., Albuquerque, N. Mex.

NEW FRONTIERS FOR NONDESTRUCTIVE TESTING IN THE NUCLEAR AGE

Douglas W. Ballard [1965] 19 p refs Presented at the IAEA Symp. on Nondestructive Testing in Nucl. Technol., Bucharest, 17–21 May 1965

(Contract AT(29-1)-789)

(SC-DC-1123; SM-63/32; CONF-650509-3) CFSTI: HC $1.00/MF $0.50

Predictions of seven new frontiers for nondestructive testing are discussed. These new frontiers include: material properties testing; research and development tools; dynamic NDT applications; multiple nondestructive testing; electronic component and systems testing; infrared tests; and microwave tests. Examples are given to reinforce each prediction. NSA

N66-18789# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

TEMPERING BEHAVIOR OF TWO PRESSURE-VESSEL STEELS

D. A. Ferrill, L. J. Di Nuzzo, and R. H. Oberdick 15 Feb. 1965 15 p ref

(Contract W-31-109-ENG-52)

(KAPL-3092) CFSTI: HC $1.00/MF $0.50

Two pressure-vessel steels (MIL-S-871, Class 2 and MIL-S-22494, Comp. A) were tested to determine the variation in hardness as a function of tempering temperature and time. The data obtained will aid in predicting changes in the hardness of these steels and their weld heat-affected zones during tempering and stress-relief treatments. Author (NSA)

N66-18803# Sandia Corp., Albuquerque, N. Mex.

DYNAMIC RESPONSES OF CYLINDRICAL SHELLS UNDER LATERAL LOADS

W. B. Murfin Jul. 1965 10 p refs

(Contract AT(29-1)-789)

(SC-TM-65-81) CFSTI: HC $1.00/MF $0.50

A solution for the dynamic response of ring structures compatible with the equilibrium equations is discussed. The response to a time-varying pressure pulse is calculated by Duhamel's integral. Author (NSA)

N66-18815# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

PIZZA: AN IBM COMPUTER CODE FOR THE PLANE STRESS ANALYSIS OF TWO-DIMENSIONAL BODIES. INPUT INSTRUCTIONS

D. C. Cornell 1 Nov. 1964 63 p refs

(Contract AT(04-3)-167)

(GAMD-5239) CFSTI: HC $3.00/MF $0.75

The PIZZA program is a numerical method for calculating the deformation and resulting stress distribution for two-dimensional bodies under plane stress conditions. The program is written in the FORTRAN IV language for the 7044 digital computer. Instructions for its use are given, and input and output are described. Execution times and optional capabilities are given, and example problems are solved. NSA

N66-18854# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

PLEXIGRAM: A PIPING FLEXIBILITY ANALYSIS PROGRAM

B. A. Gottschalk, D. L. Mc Cullough and J. R. Schmid 15 Jan. 1965 76 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6195) CFSTI: HC $3.00/MF $0.75

PLEXIGRAM is a digital computer program for the analysis of stresses and deflections in three-dimensional piping configurations. The program is able to solve simple, single branch systems; open and closed piping loops; multi-branch systems; and up to three coupled systems. Piping supports are also allowed. PLEXIGRAM computes and edits reactions, stresses, and deflections of the piping system. The transformation matrices, integrated member flexibilities, and stiffness matrices for each branch are available as optional output. Limitations of the program are listed. The running time for the program is dependent upon the size of the piping configuration: number of loops, branches, and systems. A system composed of one seven-member branch averages about 30–40 seconds of machine time on the Philco-2000-212 computer.
Author (NSA)

N66-18878# Southwest Research Inst., San Antonio, Tex.
[TESTS OF LARGE PRESSURE VESSELS] Progress Report No. 13, 18 Jan. 1965–18 Mar. 1965
Andrew G. Pickett 18 Mar. 1965 11 p ref
(Contract AT(11-1)-1228)
(SWRI-1228-57; SWRI-1228-58; SWRI-1228-59) CFSTI: HC $1.00/MF $0.50

Progress is reported on cyclic pressure tests of large-size steel pressure vessels. NSA

N66-18926# Battelle Memorial Inst., Geneva (Switzerland).
RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION Ninth Quarterly Report
W. Siegfried and S. Zimering Jul. 1965 92 p refs
(Contracts EURATOM-100-62-12 RDS; EURATOM-057-64-7 TEES(RD))
(EUR-2374; EURAEC-1432) CFSTI: HC $3.00/MF $0.75

The Extrapolation of Time-to-Rupture by Means of the Exponential Function of Real Order. The variation of the parameters of the exponential function with the temperature and the stress is studied. To establish this variation law of the parameters, several experiments of the same alloy and thermical conditions (for example 10 Cr–Mo 910) are studied. A method is being developed for the determination of the stress for a given time-to-rupture and temperature which permits, using the variation law of the parameters, determination of the dispersion before doing the extrapolation. *Extension of the Decomposition of the Rupture Process as Described in 2nd Special Report.* The influence of the relation between stress and creep rate with respect to the development of a constriction is investigated more in detail. In this way it is possible to draw conclusions on the elementary mechanism taking place during the rupture process on the basis of the shape of time-to-rupture curves. This sort of analysis also permits certain conclusions to be drawn on the embrittlement at high temperatures.
Author (NSA)

N66-18940# Centre National de Recherches Metallurgiques, Liege (Belgium).
A STUDY ON PLASTIC FATIGUE EMBRITTLEMENT IN REACTOR VESSEL STEELS Quarterly Report No. 4, Oct. 1–Dec. 31, 1964
Jan. 1965 40 p Transl. into ENGLISH from the French
(Contract EURATOM-005-63-12 TEEB)
(EURAEC-1276) CFSTI: HC $2.00/MF $0.75

The major part of the tests which have been carried out were devoted to an extension of the knowledge obtained so far on the phenomenon of plastic fatigue damage in alternate biaxial bending. Endurance curves were plotted for two of the steels at ambient temperature, and for three steels at 300°C. Fatigue tests at 300°C showed a significant influence of the maintenance periods with imposed maximum deformations: these seem to lead to some endurances from 30 to 40% below those obtained under sinusoidal stress. The effect of the aging period at 300° C was also partially studied during the test. Impact tests carried out on flat test pieces damaged by alternate bending plastic fatigue at 300°C showed that the embrittlement resulting from inflicted damage was not considerably greater than that observed after fatigue at ambient temperature. This temporary conclusion, however, only applies within the limits of the studied damage and of the methods adopted for brittleness measurements. Author (NSA)

N66-19004# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DYNAMIC STABILITY OF A CYLINDRICAL SHELL WITH AN INITIAL FLEXURE FOR A GIVEN RATE OF APPROACH OF THE END-FACES
A. I Blokhina [1961] 9 p refs Transl. into ENGLISH from Inzh. Sb. (Moscow), v. 31, 1961 p 196–201

An analysis is made of the dynamic stability of a slender, cylindrical shell, hinge supported at the edges, with an initial curvature. It is assumed that one of the end faces of the shell is fixed, while the other moves at a given constant velocity. Equations are evolved and a solution is given in the case of small deflections. It is established that the greater the loading rate of the shell, the lesser the deflection amplitude becomes. The coefficient of overloading is shown to increase with increasing loading rate and decreasing initial deflection. The minimum load sustained by the shell is obtained for the same quantity of half-waves for any loading rate. M.W.R.

N66-19034*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NONLINEAR MEMBRANE SOLUTIONS FOR SYMMETRICALLY LOADED DEEP MEMBRANES OF REVOLUTION
John N. Rossettos Washington, NASA, Mar. 1966 43 p refs
(NASA-TN-D-3297) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An explicit closed form solution is given for the equations of a nonlinear theory for deep membranes of revolution. In the theory, it is assumed that strains are small and rotations are moderately small, that is, of the order of the square root of the strains. The solution is valid when the nonlinear behavior is confined to boundary-layer regions near edges. General symmetric surface loads can be conveniently included in the form of the solution. Results are obtained for the particular cases of a pressurized membrane and a rotating spherical membrane, both attached to hubs. Also, results are given for a cap of arbitrary shape attached to a cylindrical pressure vessel and for the arrest of a moving mass by a pressurized spherical membrane. Author

N66-19124# Lockheed Missiles and Space Co., Palo Alto, Calif. Aerospace Sciences Lab.
AN INVESTIGATION OF THE PANEL COLLAPSE STRENGTH OF STIFFENED PLASTIC HEMISPHERES
E. H. Nickell and J. Skogh 1 Oct. 1965 32 p refs
(LMSC-6-75-65-53)

Sixteen 18-in.-diameter plastic hemispheres were tested to determine a method of analysis for predicting the collapse strength of panels between the ribs of a stiffened dome. Four hemispheres were unstiffened and 12 hemispheres were stiffened. Five of the 12 stiffened hemispheres had meridional and circumferential stiffeners. Three of the seven models

had rib spacing assuming the panel between ribs buckled as shallow spherical segments. The other four domes had rib spacing assuming the panels buckled as flat plates. All of the hemispheres were tested to failure by subjecting them to an external crushing pressure. The results of this study show that: (1) Panels between stiffeners of spherical shells can collapse at higher stresses than unstiffened shells; (2) the collapse stress of panels between stiffeners can be predicted by an empirical equation; (3) panels between stiffeners assumed to buckle as flat plates with simply supported edges is too conservative; (4) panel bending stresses can be important for structures subjected to repeated loading conditions yet they may not influence the collapse strength. Author

N66-19133*# North American Aviation, Inc., Los Angeles, Calif.
DESIGN INVESTIGATION OF CYLINDRICAL STRUCTURES OTHER THAN HONEYCOMB Final Report, 1 Jun.–30 Nov. 1965
S. C. Mellin 31 Dec. 1965 244 p refs
(Contract NAS8-20009)
(NASA-CR-70373; NA-65-1026) CFSTI: HC $6.00/MF $1.50 CSCL 20 K

The objective of this program is a minimum weight design investigation of unconventional structures/materials concepts for large diameter unpressurized booster shells. A unique concept, the double-wall structure, is developed in this investigation. The double-wall concept offers a significant weight advantage over conventional designs in a wide range of load levels. A two-phase program is employed to achieve lightweight structural concepts. The first phase involves a parametric theoretical study of unpressurized cylindrical shells. A matrix of over 10,000 structural/material/design points is developed. An optimization screening of the resulting designs is performed. The second phase of the program is a detailed evaluation of six selected concepts. Final data is obtained for over 300 design points. The theoretical basis of this investigation is small deflection analysis. A large deflection analysis is conducted for the most attractive detailed designs. Author

N66-19145# National Aeronautical Lab., Bangalore (India).
NATURAL FREQUENCIES AND MODE SHAPES OF THIN ELASTIC PLATES OF LINEARLY VARIABLE THICKNESS
B. Basava Raju Nov. 1965 35 p refs
(TN-SA-6-65) CFSTI: HC $2.00/MF $0.50

The natural frequencies and the node patterns for clamped and simply supported square plates of linearly variable thickness are determined experimentally using a pulsed-air vibrator. Finite difference approximation is used to solve the vibrating plate problem and the resulting eigen value problem is solved by the use of digital computer. Eigen values are the frequencies and the eigen vectors represent the relative plate amplitudes. Experimental results are compared with finite difference results and disagreements between the two. Author

N66-19177# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands). Adviesbureau der Genie.
CONNECTION BETWEEN THE TOTAL IMPULSE, WHICH ORIGINATES IN A POINT SOURCE OF A CONVENTIONAL EXPLOSION, AND THE ACOUSTIC NUMBER [HET VERBAND TUSSEN DE TOTALE IMPULS, DIE IN EEN PUNT VAN EEN MEDIUM BIJ EEN CONVENTIONELE EXPLOSIE ONSTAAT EN HET ACOUSTISCHE GETAL]
R. W. Trense Oct. 1965 17 p In DUTCH *Its* Rept.-124 (TDCK-44382) CFSTI: HC $1.00/MF $0.50

The strength and effectiveness of protective measures against conventional attack were evaluated. Linear, quadratic, and cubic relationships were used, and findings show that strikes near civilian buildings make it necessary to consider the total peak pressure. However, when the force is conducted through a liquid medium to a building the frequency is then so high that the theory of pulse and equivalent atomic pressure is considered applicable. Although, in general, the pulse-shaped character of the explosion pressures on buildings is evaluated as more important than during atomic explosions, the theory is only completely applicable for pressures in air and water. It was concluded that the complete peak pressure should be considered in structures which are exposed to ground shocks; this implies that the method of indicating the pulse as a static replacement load of 1/3 of the peak pressure is incorrect for protective buildings in the ground. Transl. by J.O.

N66-19212# Beech Aircraft Corp., Boulder, Colo.
THE DEVELOPMENT OF TITANIUM AND INCONEL CRYOGENIC PRESSURE VESSELS
R. J. Balthazar and H. E. Sutton 1 Aug. 1965 24 p ref Preprint

This paper summarizes the development of lightweight pressure vessels for the Apollo Cryogenic Storage System. The vessels store supercritical hydrogen and oxygen and are contained in a load bearing thermal protection system which provides the necessary fluid storage life and uniform vessel loading. The Ti–5Al–2.5Sn ELI alloy was selected for the hydrogen vessel and Inconel 718 was chosen for the oxygen vessel. Design considerations included limiting joints to one single girth weld and providing generous tapered sections at all discontinuities. The forge-machine method of fabrication and the electron beam technique of welding were selected over other methods. The materials, design, and weld processes were qualified by subjecting four pressure vessels from each system to pre-qualification tests. Extensive post-burst metallurgical evaluations and stress analyses, including comparisons between actual and theoretical values, were made on all ruptured vessels. A creep limit was established on the titanium material and the performance of base and weld material was evaluated at cryogenic temperatures for both materials. Author

N66-19221# Cekmece Nuclear Research Center, Istanbul (Turkey).
ON THE TWO DIMENSIONAL SOLUTIONS FOR AN ELASTIC SEMI-INFINITE MEDIUM WITH COUPLE STRESS
E. S. Suhubi (Istanbul Univ.) Apr. 1965 14 p refs
(CNAEM-25) CFSTI: HC $1.00/MF $0.50

The governing differential equations for an elastic medium with couple stress are solved for a semi-infinite region in static plane deformation by using Fourier transforms. The formal solution can be utilized in a large class of boundary value problems concerning the region in question. For an arbitrary distribution of surface tractions and moments explicit results are given and the solution is obtained for the uniformly distributed surface tractions and moments. Author

N66-19234# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFERENTIAL EQUATIONS OF ELASTIC EQUILIBRIUM OF SHELLS OF ROTATION WITH MERIDIONAL RIBS AT POWER AND TEMPERATURE LOADS

L. O. Il'yin 15 Dec. 1965 18 p Transl. into ENGLISH from Prikl. Mekhan. (Ukr. SSR), v. 10, no. 3 p 254–262
(FTD-TT-65-1230/1+2+4; AD-625162) CFSTI: HC $1.00/MF $0.50

Discussed is a thin elastic shell of rotation with meridional ribs, which can be considered thin rods. All ribs are identical and the distance between them are uniform. Thickness of the shell and rigidity of the ribs may change along the meridian. The shell is subjected to the affect of power load and non-uniform heating, which possess cyclic symmetry, corresponding to the cyclicity of rib disposition. It is assumed, that the rib is connected with the shell along the line of intersection of the center of the surface with perpendicular to it plane, in which the axis of the rib lies. By dividing into trigonometric series the given loads and reactions forces affecting the shell its reactions with the ribs and expressions of the latter through displacements of the conjugation line of the shell with the ribs was obtained an infinite system of conventional differential equations relative to shell displacements. Limiting the number of members of the decomposition, from the mentioned system can be obtained a final system of equations, which describes approximately the discussed problem and it has a fully definite mechanical sense. Author (TAB)

N66-19365# Columbia Univ., New York. Inst. of Flight Structures.
DESIGN ESTIMATES OF STRESSES AND DEFORMATIONS IN MELTING PLATES Technical Report No. 29
Edward Friedman and Bruno A. Boley Jun. 1965 100 p refs
(Contract Nonr-4259(07))
(CU-29-65-ONR-4259(07)CE; AD-626862) CFSTI: HC $3.00/MF $0.75

In order to provide calculation procedures and design estimates to determine the mechanical behavior of ablating plates subject to atmospheric reentry heating, the analysis of a melting elastic–perfectly plastic circular plate based on certain physically reasonable idealizations is considered. The plate, exposed on one face to a heat input which varies in time as a square pulse and insulated at the other face and at the edges, is acted upon by arbitrary edge loads. An approximate temperature solution, based on the extension of the penetration depth method to the melting problem, is derived and tabulated for all values of the parameters. A procedure is outlined for determining the stress distribution and deformations at all times during application of the pulse. Solutions are tabulated for certain cases in which the plate is not acted upon by edge loads. Approximate expressions are presented during the melting period to facilitate rapid design calculations. An analysis of stresses and deformations upon removal of the heat pulse is made based on the simplification of simultaneous elastic unloading throughout the plate at the time of removal of the pulse. Author (TAB)

N66-19379# David Taylor Model Basin, Washington, D. C.
ELASTIC INSTABILITY OF PROLATE SPHEROIDAL SHELLS UNDER UNIFORM EXTERNAL PRESSURE
Barry I. Hyman Dec. 1965 40 p refs
(DTMB-2105; AD-626611) CFSTI: HC $2.00/MF $0.50

The Rayleigh-Ritz method is used to obtain the governing equations for the buckling and post-buckling behavior of prolate spheroidal shells. The buckling displacements are assumed to be confined to a shallow cap, and a coordinate transformation is employed to simplify the integration of the energy expression. Graphical results are presented for several cases that demonstrate the effect of varying the eccentricity of the generating ellipse of the shell. (Paper presented at the 9th Midwestern Mechanics Conference., Madison, Wis., Aug. 15–18, 1965.) Author (TAB)

N66-19383# Mechanical Technology, Inc., Latham, N. Y.
THERMAL STRESSES IN A CONVECTIVE ELASTIC HALF SPACE ASSOCIATED WITH AN ARBITRARILY DISTRIBUTED FAST-MOVING HEAT SOURCE
V. C. Mow and H. S. Cheng Dec. 1965 27 p refs
(Contract Nonr-3729(00))
(MTI-65TR60; AD-432339) CFSTI: HC $2.00/MF $0.50

A solution of the stress field within an elastic half-space under an arbitrarily-distributed, fast moving heat source of constant velocity within two dimensional, quasi-static, uncoupled thermoelastic theory is presented. The surface is allowed to dissipate heat by convention. An example associated with the elastohydrodynamic lubrication is given.
Author (TAB)

N66-19402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE METHOD OF DYNAMIC STIFFNESS FOR CALCULATION OF THE FREQUENCY OF NATURAL OSCILLATIONS OF COMPOSITE SHELLS
I. Ye. Sakharov 30 Nov. 1965 15 p refs Transl. into ENGLISH from Russian
(FTD-TT-65-1143/1+2; AD-625159) CFSTI: HC $1.00/MF $0.50

The method for solving problems of determining the frequency of natural oscillations in composite shells by means of the method of dynamic stiffness is as follows: by laying out several cross-sections, instead of a composite shell, different shells of simple types (cylindrical, spherical, conical, etc.) are obtained. Forces (loads, moments) varying harmonically with an as-yet unknown frequency omega are introduced in the cross sections. The problems of the forced oscillations of each of the shells under the action of boundary loads are then solved. The end deflections found by solving these problems make up the dynamic stiffness, ie., the ratio of load amplitudes to the amplitudes of the deflections caused by the loads. Then, with the law of equality of interaction and the conditions of compatible deformations, an equation is evolved for the frequency of the natural oscillations of composite shells. TAB

N66-19404# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC SOLUTION OF A PROBLEM ABOUT AXIALLY SYMMETRICAL DEFORMATION OF A CONICAL SHELL OF LINEAR-VARIABLE THICKNESS
Yu. S. Korolevich 17 Dec. 1965 17 p refs Transl. into ENGLISH from Prikl. Mekhan. (Ukr. SSR), v. 5, no. 1, 1959 p 106–113
(FTD-TT-65-1373/1+2+4; AD-625805) CFSTI: HC $1.00/MF $0.50

Presented is a method for determining the elastic axially symmetrical deformation of a conical shell of linear variable thickness. The solution is derived with the aid of the asymptotic integration method. Areas of applying these solutions and an evaluation of their errors are given. M.R.W.

N66-19428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMIC PROBLEM OF THE THEORY OF ELASTICITY FOR A PLATE FROM TRANSVERSAL ISOTROPIC MATERIAL
V. I. Makhovikov 27 Oct. 1965 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mat. (Kazan), no. 4, 1964 p 111–117
(FTD-TT-65-874/1+4; AD-625790) CFSTI: HC $1.00/MF $0.50

The steady oscillations of a plate of constant thickness are considered. At a stable regime, displacements and stresses can be considered as proportional to a periodic time function, and only the boundary conditions need be satisfied. Stresses and displacements are substituted into dynamic equations of equilibrium. Conditions are obtained for the satisfaction of the equations on the bases of the plate for cases when the center plane of the plate is subjected to bending and elongation-compression. Four types of boundary conditions on the bases of the plate are discussed and solved. Displacement formulas are derived, although it is noted that boundary conditions cannot be determined for all points of the surface. E.A.O.

N66-19439# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY OF LOCAL STRAIN DURING BENDING OF A HOLLOW SHAFT

L. S. Burshteyn 8 Dec. 1965 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 2, 1964 p 123–129
(FTD-TT-65-1121/1+2+4; AD-625245) CFSTI: HC $1.00/MF $0.50

Using the strain energy method, an approximate formula is derived for determining the flattening of a hollow shaft loaded with two equal and opposite forces along the diameter. The formula proved satisfactory for the small values of shell thickness to radius ratio, a/h equals 5-25, usually encountered in hollow shafts. The same method is used for an approximate solution for the case of a shaft which is supported on the ends and loaded in the middle. The influence of local strain at the supported places of the shaft on its deflection is examined. An explanation is proposed for large deflections due to local strain on the supports, with a formula given for determining these strains. E.A.O.

N66-19443# Catholic Univ. of America, Washington, D. C.

FINITE DEFORMATIONS UNDER PRESSURIZATION IN AN INFINITELY LONG, THICK-WALLED, NONLINEARLY VISCOELASTIC CYLINDER IDEALLY BONDED TO A THIN ELASTIC CASE

Ramesh N. Vaishnav and Constantine Dafermos Sep. 1965 86 p refs
(Contract AF 04(611)-10388)
(AD-625219) CFSTI: HC $3.00/MF $0.75

A constitutive equation for a nonlinearly viscoelastic, incompressible, Mooney-Voigt material is developed. Use is made of the equation to arrive at a nonlinear differential equation for the quasistatic finite-deformational response under internal pressurization of an infinitely long, thick cylinder of a nonlinearly viscoelastic material bonded to a linearly elastic thin case. Careful mathematical analysis of the differential equation is carried out. The equation is solved numerically for step and ramp pressure programs for a realistic set of data and the results are compared with those of the corresponding linearized program. Several peculiarities of the results of the nonlinear theory are discussed at length. Author (TAB)

N66-19447*# General Dynamics/Astronautics, San Diego, Calif.

SECONDARY STRESSES IN TRUSSES

T. J. Dwyer 31 Aug. 1964 24 p refs
(NASA-CR-54577; GD/A-DDG-64-021) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Computers make it feasible to analyze a two or three dimensional truss by direct applications of the energy theorems of structural analysis. As an illustration, a sample problem for a fixed joint truss is solved by the method of secondary stresses and by a direct method which has been programmed. The print out of the problem input data is included along with a summary of the essential output. R.N.A.

N66-19451*# General Dynamics/Convair, San Diego, Calif.

SUPERSONIC FLUTTER OF A CYLINDRICAL SHELL WITH APPLICATION TO THE CENTAUR INTERSTAGE ADAPTER

R. R. Mitchell 1 Jan. 1963 54 p refs
(Contract AF 18(600)-1775)
(NASA-CR-54542; AY-62-0089) CFSTI: HC $3.00/MF $0.50 CSCL 20K

The solution for the flutter boundaries of a circular cylindrical shell subjected to supersonic flow consists of a Galerkin-type approach to the equation of motion obtained in Appendix A. Arbitrary-motion, or piston-theory, aerodynamics is used to facilitate the solution. The approach to the solution is taken in two steps. A Galerkin solution neglecting damping obtains approximate values for a subsequent, more detailed analysis. The final solution is obtained by a similar procedure with the inclusion of structural damping, aerodynamic damping, axial load, and previously neglected small bending terms and tangential inertias. Two mathematical models are derived for the Centaur interstage adapter and the results of each case indicate that modal adapter flutter will not be a problem under flight conditions. Author

N66-19486*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYSIS OF AEROELASTIC DIVERGENCE IN UNGUIDED LAUNCH VEHICLES

Vernon L. Alley, Jr. and A. Harper Gerringer Washington, NASA, Mar. 1964. 41 p refs
(NASA-TN-D-3281) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A discrete-system matrix method is developed for analyzing the aeroelastic divergence behavior of slender-body unguided launch vehicles. The solution is of the form of an eigenvalue problem that yields a divergence dynamic pressure at which divergent flight behavior will occur. A means for computing a generalized static margin that includes aeroelastic effects for the flexible vehicle is also proposed. Data necessary to accomplish an analysis are illustrated, along with example outputs. A parametric study is included to show the sensitivity of the divergence dynamic pressure and generalized static margin to variations in fin-lift characteristics. Stability criteria relating to the divergence dynamic pressure and the generalized static margin are suggested for both rigid or flexible vehicles, including those of extreme slenderness. It is believed that adherence to the suggested criteria will preclude destructive divergent behavior as well as minimize weight penalties due to aeroelastic load magnifications. The aeroelastic divergence study is shown to be necessary in establishing a compatibility between the aerodynamic and structural design. Author

N66-19496*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SCALING RELATIONSHIPS FOR MICROSCALE TO MEGASCALE IMPACT CRATERS

Donald E. Gault and Henry J. Moore (Geol. Survey) [1965] 16 p refs Submitted for publication
(NASA-TM-X-54996) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An analysis of scaling relationships is presented for impact craters formed in liquids, rocks, and metals. The roles of target strength and gravitational acceleration are considered. The controversy of whether penetration varies with the two-thirds or one-third power of the impact velocity is suggested to be academic until the effects of target strength are firmly established. Author

N66-19512*# General Dynamics/Convair, San Diego, Calif.
FLIGHT-WIND RESTRICTIONS PROCEDURE, ATLAS/CENTAUR AC-6 THROUGH AC-15
R. T. Mattson 15 May 1965 57 p refs
(Contract NAS3-3232)
(NASA-CR-54284; GD/C-B+D65-068) CFSTI: HC $3.00/MF $0.50 CSCL 20K

The starting point of the analysis is the ultimate structural capability of the vehicle. This capability, determined from the vehicle's as-built condition, is used in conjunction with the pre-calculated loads and with the loads obtained using the flight-wind profile in order to determine whether the vehicle can be safely launched. The method employed is the same as that used for the AC-4 vehicle. This method employs the calculated axial load in addition to the calculated bending moments, both being dependent upon the wind profile. Considered also are the vehicle's ultimate bending moments and axial loads and their respective factors of safety. A 30-fps gust is used in the AC-6 simulation program. A rapid analysis on the IBM 7094 computer, combined with rapid analysis of output film on a Stromberg-Carlson 4020 microfilm recorder unit, comprises the basis of a recommendation relayed to the launch complex within minutes after obtaining the flight-wind profile. A detailed outline of the complete prelaunch procedure, including criteria for launch recommendations, is presented. Author

N66-19513*# General Dynamics/Convair, San Diego, Calif.
FREQUENCY ANALYSIS OF STIFFENED CYLINDRICAL SHELLS WITH SIMPLY-SUPPORTED EDGES
G. E. Tersteeg 1 Nov. 1963 45 p refs
(NASA-CR-54605; GDA63-1067) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The stress resultant equations of motion and moment equilibrium for a cylindrical shell are modified to allow for axial and bending rigidity of frames and stringers. Appropriate stress resultant-displacement equations are formulated thus allowing the transformation of stress resultant equations to displacement equations to be made. The assumption of a simply-supported solution yields the frequency equation, which is used to calculate frequencies for the F-1 and AC-2 Centaur adapters, proposed versions of the AC-4,5 Centaur adapters, and OAO aft fairing. Since the natural frequencies of the F-1 adapter have been determined experimentally on a full size adapter it was possible to check the predictive value of the analytic frequency equation. Correlation between calculated frequencies and test frequencies of the F-1 adapter is good, thus lending confidence to the value of the analysis. Appendix A is included to display the analysis of the behavior of the derived frequency equation. This leads to an approximate equation which relates, in a simple manner, lowest natural frequency and shell parameters. Author

N66-19586*# Boeing Co., Seattle, Wash. Aerospace Group.
INVESTIGATION OF PLANE-STRAIN FLAW GROWTH IN THICK-WALLED TANKS Final Report, 26 Jun. 1964–26 Oct. 1965
C. F. Tiffany, P. M. Lorenz, and L. R. Hall Feb. 1966 179 p refs
(Contract NAS3-4194)
(NASA-CR-54837; D2-24078-1) CFSTI: HC $5.00/MF $1.00 CSCL 20K

The objectives of this investigation were to: (1) generate plane-strain fracture toughness and cyclic flaw growth data for 2219-T87 aluminum and 5Al-2.5Sn (ELI) titanium from the testing of uniaxially loaded specimens; (2) establish how and under what conditions uniaxial data can be applied to cryogenic pressure vessel design; (3) verify the applicability of the uniaxial data to cryogenic pressure vessel design. Tests were conducted on uniaxially loaded surface-flawed specimens and on biaxially stressed surface-flawed tanks fabricated from each material. Tests were conducted at room temperature in air, at −320°F in the environment of liquid nitrogen, and at −423°F in the environment of liquid hydrogen. Both zero-to-tension and half-tension-to-tension loading profiles were investigated. Replicas of some fracture surfaces were viewed through an electron microscope. Particular attention was given to striated areas. The results of this test program showed that, within the limitations of application expressed in this report, uniaxial fracture specimen data can be used in the prediction of plane-strain subcritical flaw growth characteristics and critical flaw sizes in pressure vessels. Author

N66-19589*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EQUILIBRIUM SHAPE OF AN ARRAY OF LONG ELASTIC STRUCTURAL MEMBERS IN CIRCULAR ORBIT
Thomas W. Flatley Washington, NASA, Mar. 1966 23 p
(NASA-TN-D-3073) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The equilibrium shape of an array of long elastic structural members in circular orbit under the influence of gravitational, inertial, and solar pressure forces and thermal bending is considered. Appropriate nonlinear differential equations governing the deflection of thin beams in the orbital environment are derived, and a method of solution exploiting the repetitive operation and oscilloscopic display capability of some analog computers is described. The analysis is then applied to a Radio Astronomy Explorer satellite design with four coplanar booms extending as cantilever beams from a central body, and arranged so as to act simultaneously as antennas and gravity-gradient attitude control rods. Author

N66-19591*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STIFFNESS PROPERTIES OF FOAM-FILLED FABRIC STRUCTURES
Jerry W. Deaton and George W. Zender Washington, NASA, Mar. 1966 40 p refs
(NASA-TN-D-3267) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Results on both foam-filled and air-inflated fabric structures subjected to uniaxial, biaxial, shear, or bending stresses are presented and discussed. The results indicate that the stiffness properties of the foam-filled models are superior to those of the air-inflated models when compared on a mass-stiffness basis. The results also indicate that the stiffness properties of the foam are not proportional to foam density (stiffness increases faster than density) for the range of foam density of the investigation. The highest values of stiffness for both the air-inflated and the foam-filled models are obtained when the greater yarn count of the fabric is oriented in the longitudinal direction of the specimen. The values of Poisson's ratio for the foam-filled beams were, in general, less than the values usually encountered for isotropic materials. The results also indicate that the strength in shear for the foam-filled cylinders varies linearly with foam density and inceases at about the same rate as foam density. Author

N66-19604*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PENETRATION OF POLYETHYLENE INTO SEMI-INFINITE 2024-T351 ALUMINUM UP TO VELOCITIES OF 37,000 FEET PER SECOND

B. Pat Denardo Washington, NASA, Mar. 1966 11 p refs (NASA-TN-D-3369) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Penetration parameters are presented for 1/3-caliber polyethylene cylinders impacting semi-infinite 2024-T351 aluminum targets at velocities ranging from 20,000 to 37,000 ft/sec. Variations of the penetration parameters with impact velocity indicate, in accord with the trends previously established at lower speeds, that penetration depth increases with the two-thirds power of velocity. This power law is currently in use by most investigators for the fluid-impact region. Author

N66-19666*# General Dynamics/Convair, Huntsville, Ala.
A MONOGRAPH ON LATERAL VIBRATION MODES
22 Feb. 1965 93 p refs
(Contract NAS8-11486)
(NASA-CR-70712; GD/C-DDF-65-001) CFSTI: HC $3.00/MF $0.75 CSCL 20K

This monograph discusses the lateral model development and modal calculations for the cylindrical space vehicle system and also systems employing clustered tanks. Relative importance of physical characteristics will be discussed as well as methods used by the industry for the solution of modal parameters. Primary attention is focused on parameters important in control and stability analyses for which the system frequency of interest is generally below twenty cycles per second and quite often below ten cycles per second. Application for loads analysis follows the same principals outlined herein but may require more detailed representation in areas where loads or deflections can be critical. The models described will be concerned with gross vehicle lateral motions and will not include the shell radial deflection modes which can be significant for local effects analysis but generally do not contribute to gross vehicle control and stability. Related monographs describe torsional, longitudinal, and sloshing models. Stability and loads analytical methods using these models and modal parameters are also subjects of other monographs. Author

N66-19752*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRAIN MEASUREMENTS CONDUCTED ON A FULL SCALE ECHO II PASSIVE COMMUNICATIONS SATELLITE BALLOON
Charles L. Staugaitis and Lawrence Robren Washington, NASA, Mar. 1966 26 p refs
(NASA-TN-D-3126) CFSTI: HC $2.00/MF $0.50 CSCL 22B

A photogrammetric method and analysis for determining the strains developed in the skin of the Echo II passive communications satellite in a prelaunch static inflation test is described. The accuracy of these measurements is questionable due to the complexity of the strain pattern developed, however, a determination of the strain pattern set up in the skin of the balloon and reasons for their deviation from a balanced biaxial condition are examined. Comparison of these experimental strain measurements obtained by photogrammetric techniques with values determined from theoretical calculations and reasons for deviations are reviewed. Finally, tensile properties for the Echo II material obtained from biaxial bulge tests and tensile tests are measured and a comparison of these values with the actual performance of the balloon during the static inflation tests is discussed. Author

N66-19753*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL FLUTTER RESULTS FOR CORRUGATION-STIFFENED AND UNSTIFFENED PANELS
Deene J. Weidman Washington, NASA, Mar. 1966 34 p refs (NASA-TN-D-3301) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The results of a flutter investigation of 19 corrugation-stiffened and 6 flat unstiffened rectangular panels are presented. These results show that boundary conditions in the cross-stream direction have an important effect on panel flutter. It is also shown that the flutter of square orthotropic panelsis not easily predicted, and that, at present, a flutter envelope appears to be the best available means for the prediction of the flutter boundaries for such panels. In addition, a method for analyzing the stiffness of corrugation-stiffened skin panels is presented. A "preflutter" solution is shown to approximate accurately the exact solution for simply supported panels with in-plane tension loads, but both solutions differ considerably from the experimental results. Author

N66-19754*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF SIDE-EDGE BOUNDARY CONDITIONS AND TRANSVERSE SHEAR STIFFNESSES ON THE FLUTTER OF ORTHOTROPIC PANELS IN SUPERSONIC FLOW
Deene J. Weidman Washington, NASA, Mar. 1966 42 p refs (NASA-TN-D-3302) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The basic linearized equations for orthotropic panel flutter are solved by the Galerkin method for simply supported leading and trailing edges and various side-edge support conditions. In addition, allowance is made for the finite transverse shear stiffness of simply supported panels. The qualitative results show that both transverse shear stiffness and side-edge boundary conditions can be extremely important in determining the flutter boundaries for orthotropic panels. Author

N66-19755*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BENDING TESTS OF LARGE-DIAMETER RING-STIFFENED CORRUGATED CYLINDERS
James P. Peterson and James Kent Anderson Washington, NASA, Mar. 1966 33 p refs
(NASA-TN-D-3336) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Results of bending tests on five ring-stiffened corrugated cylinders are presented. The cylinders failed by buckling into a general-instability mode involving buckling of the corrugated wall and reinforcing rings as a composite wall. Buckling in this mode occurred at a load approximately 75 percent of the load computed with the use of a small-deflection buckling theory of cylinders in bending. One of the test cylinders buckled into a panel-instability mode (buckling of corrugated wall between stiffening rings) prior to buckling into the general-instability mode. Buckling in the panel-instability mode was accurately predicted with the use of the theory. Author

N66-19757*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BUCKLING OF ECCENTRICALLY STIFFENED ORTHOTROPIC CYLINDERS UNDER PURE BENDING
David L. Block Washington, NASA, Mar. 1966 22 p refs (NASA-TN-D-3351) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The stability of stiffened orthotropic cylinders which include the effects of eccentric stiffeners and are loaded with pure bending or any combination of bending and compression is investigated analytically by means of a small deflection theory. Solutions to the buckling equations are obtained for simple support boundary conditions by use of the Galerkin method. The pure bending buckling loads are compared with existing pure compression buckling loads for three contemporary cylinder configurations. Also shown are predicted

buckling modes and typical interaction curves between bending and compression. The results show that eccentricity effects are substantial and that the maximum pure bending load may be as much as 40 percent greater than the pure compression load. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-18510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOELECTRIC COOLING AND ITS PRACTICAL APPLICATION
A. R. Regel' and Ye. A. Kolenko 8 Dec. 1965 20 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, 1964 p 86–92
(FTD-TT-65-1055/1+2+4; AD-625292) CFSTI: HC $1.00/MF $0.50

Thermoelectric cooling utilizing semiconductor devices. TAB

N66-18542# California Univ., Riverside.
THERMODYNAMICS OF THE LIQUID-LIQUID CRITICAL MIXING REGION Final Report, 5 Mar. 1958–31 Dec. 1963
Hartland H. Schmidt and Jack Opdycke 15 Feb. 1965 38 p refs
(Contract AF 49(638)-284)
(AFOSR-64-1758; AD-625455) CFSTI: HC $2.00/MF $0.50

An improvement was made upon the apparatus used for heat capacity measurements and the measurements were refined to the extent that they can now reasonably be expected to give data of the high order of precision required for crucial tests of theories. The bulk of the report is devoted to a description of the apparatus developed, the art involved in its operation, and the results obtained on two particular critical systems. An attempt was made to measure the partial vapor pressure and hence the fugacity of components in a liquid-liquid near-critical mixture as a function of composition. TAB

N66-18553# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON DETONATION COMBUSTION OF HETEROGENEOUS SYSTEMS
V. Ye. Gordeyev, V. F. Komos, and Ya. K. Troshin 3 Dec. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 160 no. 4, 1965 p 853–856
(FTD-TT-65-1106/1+2+4; AD-625158) CFSTI: HC $1.00 MF $0.50

The transition from combustion to detonation of a thin layer of lubricating oil in an oxygen filled tube was studied, using a high speed photographic system to record the process. Various methods were used to initiate combustion, including shock waves and electric discharges. An investigation conducted to determine the amount of oil per unit area necessary for an accelerating combustion established two critical values, one corresponding to detonation and the other corresponding to explosion. Under the conditions of the experiments, combustion was observed to accelerate from 200 m/sec to 800 m/sec over a distance of 600 mm. D.T.

N66-18598# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TRANSIENT THEORY OF THERMAL SELF-IGNITION
S. A. Kaganov 17 Nov. 1965 16 p refs Transl. into ENGLISH from Yh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 1, 1965 p 62–67
(FTD-TT-65-1018/1+4; AD-625151) CFSTI: HC $1.00/MF $0.50

A transient theory of thermal explosion is constructed, and the reaction rate and the spatial distribution of temperature in the reaction vessel are considered. The theory accounts for the change in concentration of the reacting substance throughout the reaction. The parameters characterizing the explosives are discussed. TAB

N66-18599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOWARD A THEORY OF STABILITY OF POWER COMBUSTION
S. S. Novikov and Yu. S. Ryazantsev 17 Nov. 1965 13 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1965 p 57–61
(FTD-TT-65-1114/1+2; AD-625059) CFSTI: HC $1.00/MF $0.50

The method of small perturbations to study the stability of powder combustion with consideration of heat release in the surface of the condensation phase (k-phase), assuming that the combustion zone in the gas and the region of the chemical reaction in the k-phase immediately adjacent to the gasification surface are without inertia. A stability condition for powder combustion is derived for the two possible combustion regimes. TAB

N66-18602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MECHANISM OF BOILING OF LIQUID SODIUM ON A HEATING SURFACE AT FREE CONVECTION
V. I. Deyev and A. N. Solov'yev 27 Oct. 1965 13 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 6, 1964 p 8–12
(FTD-TT-65-907/1+4; AD-625791) CFSTI: HC $1.00/MF $0.50

Evaluated are the critical nucleus radius, the growth rate and separation diameter, the bubble separation frequency with sodium boiling on a heating surface with natural convection. It has been shown that all these quantities differ essentially from the similar ones with water boiling at a normal pressure. Author (TAB)

N66-18603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE MATHEMATICAL PROBLEM OF THE THEORY OF HEAT MASS TRANSFER
Ya. S. Rabinovich 8 Dec. 1965 10 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (USSR), v. 7, no. 11, 1964 p 67–72
(FTD-TT-65-1137/1+4; AD-625066) CFSTI: HC $1.00/MF $0.50

Heat and mass transfer in the stratified turbulent atmosphere are discussed. The diffusion equation is solved for a two-layer model. The coefficient of turbulent exchange and

wind profile are assumed to be power functions of height in the lower layer of the atmosphere and exponents in the upper layer, the solutions being conjugated on the boundary between these two layers. Author (TAB)

N66-18652# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).
HETEROGENEOUS COMBUSTIONS AND FLAMES STRUCTURES Final Report, Apr. 1, 1963–Mar. 31, 1965
Carlos Sanchez Tarifa [1965] 61 p refs
(Grant AF-EOAR-63-44)
(AFOSR-65-1791; AD-625015) CFSTI: HC $3.00/MF $0.75

Flame propagation along the surface of a liquid fuel is studied. The problem of heat exchange in the fuel is considered. Fundamental equations, boundary conditions, and experimental results are given. The structure of the hydrogen–oxygen diffusion flame with spherical symmetry is considered. TAB

N66-18659# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF DETERMINING THE FUEL COMPONENTS IN GASEOUS MIXTURES
M. V. Rak 30 Nov. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 166532 (Appl. no. 834366/26-25, 3 May 1963) 1 p
(FTD-TT-65-1157/1+4; AD-625185) CFSTI: HC $1.00/MF $0.50

A method of determining the combustible components of gaseous mixtures with the use of a thermochemical pick-up is presented. To eliminate the influence of noncombustible components in the combustible components is determined by measuring the speed of the change in the signal of the pick-up. This may be accomplished with an electrical bridge by means of the differentiation of the signal with the aid, for example of an RC filter. TAB

N66-18663# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREE HEAT CONVECTION IN TURBINE CLEARANCE
V. A. Arkad'yev 30 Nov. 1965 7 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 2, 1965 p 204–206
(FTD-TT-65-1135/1+2+3+4; AD-625265) CFSTI: HC $1.00/MF $0.50

Since the convective heat transfer in turbine rotor clearances must be taken into account, the problem of free heat convection in axisymmetrical clearances with mass forces of variable acceleration is discussed, and methods of solution are outlined. Author (TAB)

N66-18692# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
HEAT TRANSFER AND TEMPERATURE DISTRIBUTION IN FINNED RADIATORS
Maurice W. Wildin Aug. 1965 74 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-DC-65-1765; ME-15) CFSTI: HC $3.00/MF $0.75

Some fundamental concepts and material properties used in radiant heat transfer are defined, relations between material properties are discussed, and methods of rigorously formulating a couple of fairly broad classes of problems are presented. Simplifications in formulation which result from various assumptions are also discussed. As an example of the value and limitations of analyzing limiting cases, the problem of radiant heat transfer between infinite parallel flat plates which are neither purely specular nor purely diffuse reflectors was solved. An approximate method was used which assumes that the directional distribution of energy reflected from an element of a plate can be described by combining a diffuse field and a specularly reflected beam. The numerical results showed that the spectral net heat flux is quite insensitive to the relative amounts of diffusely and specularly reflected energy. Author (NSA)

N66-18708# Michigan Univ., Ann Arbor. Dept. of Chemistry.
HEAT CAPACITY AND THERMODYNAMIC PROPERTIES OF ZIRCONIUM TETRAFLUORIDE FROM 5 TO 307°K
Edgar F. Westrum, Jr. Nov. 1964 12 p refs Submitted for Publication
(Contract AT(11-1)-1149)
(COO-1149-30) CFSTI: HC $1.00/MF $0.50

The heat capacity of ZrF_4 was determined from 5 to 307° K by adiabatic calorimetry. No thermal anomaly was detected and a normal sigmoid curve represents the data. The heat capacity (C_p), entropy (S^0), enthalpy function $[(H^0-H^0_0)/T]$, and free energy function $[-(F^0-H^0_0)/T]$ are, respectively, 24.79, 25.00, 14.03, and 10.97 cal/(gfm °K) at 298.15° K Author (NSA)

N66-18758# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EQUILIBRIUM SOLID SOLUTIONS OF NITROGEN IN Cb-1%Zr BETWEEN 1200°–1800°C
H. Inouye [1964] 19 p refs Presented at the Symp. on Phys. Met. of Refractory Metals, French Lick, Ind.
(Contract W-7405-ENG-26)
(ORNL-P-1677; CONF-651025-1) CFSTI: HC $1.00/MF $0.50

An ultrahigh vacuum technique capable of measuring sorption rates as low as 4×10^{-3} ppm N/hr and pressures of 10^{-10} torr of nitrogen was used to measure the thermodynamic properties of solutions of nitrogen in Nb–1% Zr between 1200–1800°C. In the composition range 31–278 ppm N, the solutions obeyed Sievert's law. An anomalous solution behavior that was dependent on the X_N, the amount of nitrogen in solution, occurred between 1200°–1400°C and was attributed to an oxygen–nitrogen interaction. The partial molar free energy expression for the dissolution of nitrogen in the normal solutions was $\Delta\bar{F}^0_N=-51,500+20.74T$.
Author (NSA)

N66-18770# Los Alamos Scientific Lab., N. Mex.
THEORY OF HEAT PIPES
T. P. Cotter 26 Mar. 1965 34 p refs
(Contract W-7405-ENG-36)
(LA-3246-MS) CFSTI: HC $2.00/MF $0.50

A heat pipe is a self-contained structure that achieves very high thermal conductance by means of two-phase fluid flow with capillary circulation. A quantitative engineering theory for the design and performance analysis of heat pipes is given. Author (NSA)

N66-18771# Los Alamos Scientific Lab., N. Mex.
THERMAL RADIATION FROM BURNING HYDROGEN PLUME
Paul E. Martin [1965] 5 p Presented at the 20th Ann. Conf. of the Instr. Soc. of Am., Los Angeles
(Contract W-7405-ENG-36)
(LA-DC-7313; CONF-651002-6) CFSTI: HC $1.00/MF $0.50

Liquid hydrogen passes through a nuclear reactor, is ejected skyward, and ignited. Its thermal radiation pattern is to be studied so that expected heat radiations may be calculated for locations near the test pad. Several sensors-

commercial and home made—are used to determine the thermal radiation received at discrete points. From measured radiation, range, assumed plume height, and sensor orientation and height, the average thermal emitting power per unit distance along the vertical plum is calculated. Author (NSA)

N66-18775# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.

STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM Quarterly Progress Report, 1 Oct.–31 Dec. 1964

11 Jan. 1965 62 p

(Contract AT(11-1)-1186)

(ACNP-64030; EURAEC-1286) CFSTI: HC $3.00/MF $0.75

The design and construction of a 10-inch diameter upcomer separator test model and the other necessary test internals for the high-pressure steam-water loop have been completed. Testing of the horizontal separator continued with improvement being made in the areas of carryunder and pressure drop. Testing of the 360-degree hooded crossover in the high-pressure steam-water loop has been completed. Results show that the separator gives some definite improvement to the carryunder problem. The chevron type dryer has been tested over the pressure range of 600 to 1800 psi. Release rate break points as well as absolute quality values in the threshold region were obtained for all pressures. The mesh type dryer has been installed and testing is in progress.

Author (NSA)

N66-18779# California Univ., Berkeley. Lawrence Radiation Lab.

SIMILARITY PRINCIPLE AND ISOTOPE EFFECT IN SUPERCONDUCTING INDIUM. LOW-TEMPERATURE HEAT CAPACITY OF NIOBIUM

Nail Mehmet Senozan (Ph.D. Thesis) Jan. 1965 105 p refs

(Contract W-7405-ENG-48)

(UCRL-11901) CFSTI: HC $4.00/MF $0.75

Theories predict that the critical field curves of the isotopes of a superconductor are similar if the lattice contributions, C_{ln} and C_{ls}, to the normal and superconducting state heat capacities of this superconductor are the same. Recent measurements have indicated that the low temperature heat capacity of indium is anomalous; C_{ls} is about 15% smaller than C_{ln}. In order to see whether this anomaly is reflected in the critical fields as the theories predict critical field measurements between 1°K and the transition temperature 3.4°K were made on five isotopically enriched indium specimens. It was found that the critical fields are similar within one part in 600 and, furthermore, that the isotope effect is present—the transition temperature, T_c, being dependent on the isotopic mass, M, as $T_c \alpha M^{-1/2}$. Also an attempt was made to investigate whether the indium anomaly is unique or whether it is common to other superconductors. Niobium was chosen because its high transition temperature, 9.2°K, allows one to work at very low reduced temperatures where, according to the BCS theory the electronic contribution to the heat capacity of the superconducting state becomes negligible and a comparison of the lattice terms is possible. Using a ^3He calorimeter measurements between .25 and 25°K were made on a single crystalline specimen of niobium in which the total impurities were less than 80 parts per million. It was found that at low teperatures ($T \leq 5$°K) the normal state heat capacity, C_n, is best represented as $C_n = 7.85 + 0.0915\ T^3 + 0.0010\ T^5$ millijoules/mole degree. The behavior of the superconducting state heat capacity, C_s, is striking. At very low temperatures it does not approach C_{ln}, the normal state lattice heat capacity; in fact, it does not have a T^3 dependence. The results are best understood by assuming equal lattice contributions in the normal and superconducting state heat capacities. The superconducting state heat capacity can then be written as $C_s = C_{es} + 0.0915\ T^3 + 0.0010\ T^5$ millijoules/mole degree where C_{es} is best represented by $C_{es} = (7.85\ T_c)(7.85\ e^{-1.49(T_c/T)} + 2.6 \times 10^{-3}\ e^{-0.053(T_c/T)})$ millijoule/mole degree. This suggests that the energy gap in niobium is very strongly anisotropic. Author (NSA)

N66-18791# Brussels Univ. (Belgium). Faculty of Sciences.

THERMODYNAMIC STUDIES BY MASS SPECTROMETRY. THERMODYNAMIC STUDY OF THE URANIUM–OXYGEN SYSTEM BY MASS SPECTROMETRY: THE HEAT OF SUBLIMATION OF URANIUM [ETUDES THERMODYNAMIQUES PAR SPECTROMETRIE DE MASSE. ETUDE THERMODYNAMIQUE DU SYSTEME URANIUM–OXYGENE PAR SPECTROMETRIE DE MASSE: LA CHALEUR DE SUBLIMATION DE L'URANIUM]

A. Pattoret, S. Smoes, and J. Drowart 1965 60 p refs In FRENCH

(Contract EURATOM-003-63-3 DIRB)

(EUR-2458.f)

Uranium vapor pressures and partial pressures of uranium and UO and UO_2 molecules in the system $U(l)+UO_2(s)$ were measured by mass spectrometry. The heat of sublimation calculated from the uranium pressures is ΔH^0_0, s(U)= 125.5 ±2.5 kcal/atmg. The consistency of this value with the thermodynamic data for the evaporation of uranium oxides and carbides was critically examined and found to be satisfactory. Author (NSA)

N66-18799# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.

TWO-PHASE FLOW AND BOILING HEAT TRANSFER Quarterly Progress Report, Apr.–Jun. 1965

G. B. Wallis, J. M. Turner, P. E. Meyer, and D. E. Runge [1965] 13 p refs

(Contract AT(30-1)-3114)

(NYO-3114-9; EURAEC-1451) CFSTI: HC $1.00/MF $0.50

Work on co-current upwards annular flow is continuing. An investigation of upwards annular-mist vertical flow was undertaken. A summary is given of work on the rise velocity of cylindrical bubbles in inclined tubes. Author (NSA)

N66-18829# Clarkson Coll. of Technology, Potsdam, N. Y. Div. of Research.

A FUNDAMENTAL STUDY OF HEAT AND MASS TRANSFER IN THE CONDENSATION OF MULTICOMPONENT SYSTEMS Progress Report

Joseph Estrin and T. W. Hayes 24 Feb. 1965 49 p

(Contract AT(30-1)-2765)

(NYO-2765-1) CFSTI: HC $2.00/MF $0.50

A paper summarizing work completed during the period concerning a computational technique for mass transfer of vapor mixtures of more than one component is noted but not included; this work is to be published in the A.I.Ch.E. Journal. Summaries of other work during the period are presented. The condensation process in which two condensable components are involved and the mass transfer process consequently involving their partial fractionation are described. A discussion of the Bedingfield correction for the effect of molecular weight difference of the diffusion components upon the mass transfer coefficient leads to its necessary association with the Ackerman factor for the general mass transfer effect. Data from two sets of experiments using different apparatus demonstrate the use of this net corrective factor and also demonstrate the general applicability of the Drew–Colburn

mass transfer coefficient for transfer processes in which more than one component transfers phase. The results indicate that the value of the Drew–Colburn coefficient is not seriously affected by molecular-weight differences of the components and by the rate of mass transfer. Research on the effect of mass transfer from a fluid phase on the heat transfer coefficient (and mass transfer coefficient when physical properties vary little) is also described making use of the eddy diffusivity concept. A flat plate is considered over which an incompressible fluid flows; the turbulent boundary layer is steady and well established at the region of interest and mass is being transferred to the solid surface. The Schmidt number or Prandtl number or both are greater than one to the extent that the transfer of heat and mass may be completely described by consideration of the region of flow adjacent to the solid surface in which the effect of the wall is manifest in the momentum transfer process. The vapor velocity parallel to the plate and at some distance from it is greater than the velocity at the interface and directed perpendicular to it. This permits examination of the transfer using well accepted concepts. The flat plate is no great restriction since this geometry when coupled with the above Prandtl number and Schmidt number requirements does not differ in the region of interest because of the momentum transfer process from the round tube geometry. Also, using flat plate geometry permits use of the corresponding equations of motion and continuity which are simpler than those for other geometries. The discussion is concerned with the determination of the mass transfer effect on the transfer coefficients for heat and mass rather than the presentation of absolute profiles, and the results may be considered general within the limitations of straight geometries and Schmidt and Prandtl numbers in the region of unity and greater. NSA

N66-18837# Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX Quarterly Progress Report, 15 Dec. 1964–15 Mar. 1965
A. E. Bergles, E. G. Doyle, L. G. Clawson, M. Suo, W. M. Rohsenow et al 1 Apr. 1965 24 p refs
(Contract AT(30-1)-3304)
(NYO-3304-4) CFSTI: HC $1.00/MF $0.50

Completed and anticipated modifications to the experimental facility are described. Recent experimental results for flow regimes in an 8-ft 0.4-in. i.d. test section at 500 psia are discussed in detail. Author (NSA)

N66-18858# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES First Quarterly Progress Report, Oct. 26, 1964–Jan. 25, 1965
Feb. 1965 22 p refs
(Contract AT(04-3)-189)
(GEAP-4798) CFSTI: HC $1.00/MF $0.50

An annular test section for air-water measurements is now ready. Special instruments are being built for flow structure measurements. Thirty-six critical heat flux data points have been obtained with the nine-rod test section at a pressure of 1000 psia and mass flow rates of 0.3×10^6, 0.5×10^6, 0.75×10^6, 1.0×10^6, and 1.25×10^6 lb/hr-ft^2. The critical heat flux increased with decreasing quality, and with decreasing flow rate for flows less than 0.5×10^6 lb/hr-ft^2. The data are generally higher than single-rod annulus data, particularly at higher steam qualities. NSA

N66-18863# Los Alamos Scientific Lab., N. Mex.
PRACTICAL APPLICATION OF THERMODYNAMICS TO PLUTONIUM PROCESS REACTIONS AT HIGH TEMPERATURE
J. A. Leary and L. J. Mullins 11 Jun. 1965 18 p refs Presented at the Symp. on Thermodyn. with Emphasis on Nucl. Mater. and Atomic Transport in Solids, Intern. Atomic Energy Agency, Vienna, 22–27 Jul. 1965
(Contract W-7405-ENG-36)
(LA-DC-6947; CONF-650704-9) CFSTI: HC $1.00/MF $0.50

The important high temperature reactions for processing Pu involve equilibria between liquid metal and fused salt phases. Estimates are made of equilibrium concentrations for the following processes: fused salt extraction, electrorefining, bomb reduction, and oxide drossing of liquid Pu fuels. Container materials for Pu are considered briefly. NSA

N66-18871# Aktiebolaget Atomenergi, Stockholm (Sweden).
EFFECT OF BUOYANCY ON FORCED CONVECTION HEAT TRANSFER IN VERTICAL CHANNELS—A LITERATURE SURVEY
Ajay Bhattacharyya Mar. 1965 27 p refs
(AE-176)

A survey was made of available information on the effects of free convection flow on forced convection heat transfer in vertical channels. Both theoretical and experimental investigations are included. Nearly all of the theoretical investigations are concerned with laminar flow with or without internal heat generation. More consistent data are available for upward flow than for downward flow. Curves are presented to determine whether free convection or forced convection mode of heat transfer is predominant for a particular Reynolds number and Rayleigh number. At $Re_b > 10^5$ free convection effects were found to be negligible. 39 references are included. Author (NSA)

N66-18962# Iowa State Univ. of Science and Technology, Ames.
PREDICTION OF PEAK HEAT FLUX IN BOILING HEAT TRANSFER
Bernard P. Breen and George Burnet 21 Apr. 1965 26 p refs Presented at the AIChE Symp., Minneapolis, 26–29 Sep. 1965 Submitted for Publication
(Contract W-7405-ENG-42)
(IS-1137; CONF-650905-1) CFSTI: HC $2.00/MF $0.50

Single wire thermocouples spot welded to the surface of a steam-heated, polished, horizontal, stainless-steel tube produced characteristic signals during nucleate and transition boiling of acetone. A point of strong discontinuity in measured boiling surface temperature was evident when a given thermocouple site went from nucleate into transition boiling. A unique method was developed for promoting early transition at a thermocouple site by implanting at the site a small slug of high thermal conductivity material. The signal from the thermocouple at this site could then be used to predict the approach to peak heat flux. Author (NSA)

N66-19037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC AERODYNAMIC HEATING TESTS ON A LIGHTWEIGHT EXTERNAL INSULATION SYSTEM FOR LIQUID-HYDROGEN TANKS OF BOOST VEHICLES
Reeves P. Cochran and Robert W. Cubbison Washington, NASA, Mar. 1966 21 p refs
(NASA-TN-D-3300) CFSTI: HC $0.20/MF $0.50 CSCL 01A

A development program on a lightweight, sealed-foam, constrictive-wrapped external insulation system for liquid-hydrogen tanks on boost vehicles has resulted in a very promising system design. Aerodynamic heating tests have been performed previously on this system at subsonic conditions and transonic-supersonic conditions up to Mach 2 to simulate part of an assumed typical launch trajectory. The current investigation extended the environmental testing conditions to Mach 3.5 and free-stream total temperatures up to about 650° F. The free-stream dynamic pressures were between 500 and 620 pounds per square foot. These environmental conditions resulted in insulation surface temperatures that approximate those encountered at these Mach numbers during the launch trajectory. Because of the test facility operating characteristics, the time of exposure at the test conditions was about 2.4 hours compared with about 3 minutes for the launch trajectory. In general, the insulation system successfully withstood the effects of the supersonic aerodynamic heating tests. Results of this and other aerodynamic heating investigations on the insulation system indicate that the system appears to be satisfactory for withstanding the aerodynamic environment of a typical launch trajectory. Author

N66-19136*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF SOLAR SIMULATOR OPERATING CHARACTERISTICS ON SPACECRAFT THERMAL TESTS
L. B. Katter and M. E. Kahn 15 Jul. 1964 36 p refs
(Contract NAS7-100)
(NASA-CR-70368; JPL-TM-33-175) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A study has been made to determine the effect of various solar simulator operating characteristics on spacecraft thermal tests. Characteristics considered are: (1) the effects of decollimation; (2) spectral mismatch; and (3) axial and radial variations of energy flux density. In addition, the effect of solar simulator optics in the chamber has been considered for certain special cases. Author

N66-19150*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS Quarterly Progress Report No. 13, Jul. 1–Sep. 30, 1965
D. R. Ferguson and F. E. Tippets, ed. 29 Oct. 1965 322 p refs
(Contract NAS3-2528)
(NASA-CR-54890) CFSTI: HC $7.00/MF $1.75 CSCL 20M

Results of program conducted to obtain two-phase heat transfer and fluid flow data for potassium under conditions of boiling and condensing approximating those anticipated in large space turbo-electric power systems are summarized. Reported are data covering two-phase pressure drop, boiling heat transfer coefficients, critical heat flux determinations, transition boiling heat transfer coefficients, condensing heat transfer coefficients, and superheated vapor transfer coefficients. Status reports and descriptions are given for the 300 KW, 100 KW, and 50 KW projects and facilities. M.W.R.

N66-19257# Naples Univ. (Italy). Istituto di Aerodinamica.
RESEARCH ON SUPERSONIC FLOW AROUND THREE DIMENSIONAL POINTED BODIES Final Report
L. G. Napolitano Dec. 1964 76 p refs
(Contract AF 61(052)-327)
(IA-121; AFOSR-65-1710; AD-625870) CFSTI: HC $3.00/MF $0.75

A review of research on non-equilibrium flows is presented. The work is divided into two parts, containing published and unpublished research, respectively. Part I deals with the thermodynamics and dynamics of multireacting mixtures. By starting from basic postulates, a self-consistent and complete thermodynamic theory is formulated. The study of the dynamics is mostly limited to the linearized approximation and falls within two categories: (a) formulation of basic equations and analysis of their overall properties; and (b) the solution of typically representative flow fields. Part II deals with the derivation and discussion of the potential equation for linearized steady motion of a multireacting mixture within the volume-viscosity analogy. Also, the notion of thermodynamic characteristic speeds introduced in Part I is generalized, and a more exhaustive study of its properties is made. Author (TAB)

N66-19386*# United Nuclear Corp., White Plains, N.Y.
THERMAL CONDUCTIVITY OF HYDROGEN FROM 2000° TO 4700°F
S. L. Israel, T. D. Hawkins, and S. C. Hyman Washington, NASA, Mar. 1966 65 p refs
(Contract NAS3-3205)
(NASA-CR-403) CFSTI: HC $3.00/MF $0.75 CSCL 20M

The thermal conductivity of hydrogen was determined indirectly from measured effective thermal conductivities of porous tungsten specimens in a pressurized hydrogen atmosphere. Measurements were made at pressures of 150, 100, 50, and 15 psia and at temperatures to 4700° F. A truncated-sphere model was used to relate the gas and solid heat transfer contributions in the porous structure. From the model, a relationship is derived which permits determination of the hydrogen thermal conductivity from the measured effective conductivity of the hydrogen-filled porous tungsten specimens when the particle contact area is specified. The particle contact area for each specimen was determined from its measured effective conductivity in vacuum. The effective thermal conductivity of the hydrogen-filled porous tungsten structure was determined from temperature measurements on the upper circular surface of the right circular cylindrical specimens heated by radio-frequency (r-f) induction currents. A numerical analysis of this boundary value problem was used to relate the measured surface temperature distribution to the axial temperature gradient at the center of the top surface. This axial temperature gradient was used to calculate the effective conductivity of the specimen by equating the heat flux at the center of the top surface to the radiation and natural convection losses at the same point. Author

N66-19423# Battelle Memorial Inst., Columbus, Ohio.
DETERMINATION OF ANALYTICAL TECHNIQUES AVAILABLE TO DETERMINE MATERIAL SUITABILITY FOR TURNING OF HOT GASES
Ira M. Grinberg China Lake, Calif., NOTS, May 1965 56 p refs
(Contract N123(60530)51201A)
(NAVWEPS-8746; NOTS-TP-3814; AD-626430) CFSTI: HC $3.00/MF $0.50

The report presents the results of a state-of-the-art survey of the analytical techniques available to predict material suitability for turning hot gases such as the exhaust from a rocket combustion chamber. The information on two-phase and single-phase subsonic flow is curved and straight sections was obtained from pertinent literature and conversations with technical workers in the field. Major emphasis was placed on flow mechanics of the exhaust, chemical effects between

the exhaust and the walls of the duct, heat-transfer interactions between the exhaust and the duct walls, and performance of materials exposed to the exhaust environment. These factors were considered both in curved and straight channels. The analytic capabilities identified during the program are reviewed and summarized, and limitations in these capabilities are pointed out. Recommended areas in which future fundamental work would be most fruitful are also presented. A bibliography of pertinent literature and a listing of individuals contacted during the program are included. Author (TAB)

N66-19425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT EMISSION IN THE TURBULENT MOVEMENT OF A LIQUID IN A CIRCULAR CHANNEL
V. P. Isachenko and N. M Galin 3 Jan. 1966 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 6, 1965 p 68–73
(FTD-TT-65-1774/1+2+4; AD-626967) CFSTI: HC $1.00/MF $0.50

The average heat emission in the flow of water in a smooth straight channel with a circular cross section was determined experimentally. The heat exchange took place through the inner wall of the channel. Flow rates of the heat carriers and their temperatures at the input and output of the heat exchanger were measured with the aid of a set of normal diaphragms. The diaphragms were calibrated by the weight method directly on the experimental setup. The temperatures were measured by copper-constantan thermocouples. Experimental results are shown and refinements are made to the formula for calculation of heat exchange under the conditions of the experiment. E.E.B.

N66-19460*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DETERMINATION OF HEAT-SHIELD CHAR-FRONT RECESSION WITH A NUCLEONIC TECHNIQUE
William G. Davis Washington, NASA, Mar. 1966 18 p refs
(NASA-TN-D-3264) CFSTI: HC $0.20/MF $0.50 CSCL 20M

A discussion of the development of a radio-nuclide technique is presented, showing how to determine the amount of Apollo heat-shield virgin-material recession (char) occurring during an atmospheric re-entry. This technique utilizes a radioactive source inserted into the heat shield. This source decomposes and outgasses under the same conditions as does the heat-shield material. As portions of the source are removed through the processes of decomposition and sublimation, total radioactivity remaining will decrease at a rate proportional to the amount of virgin material remaining in the heat shield. A comprehensive evaluation program using arc-jet, rocket-exhaust, and oxygen-acetylene torch facilities, is presented. Various sources of error are analyzed, and estimates of total system accuracy are developed. Author

N66-19490*# Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS, VOLUME III Interim Final Report, Jul. 1, 1959–Dec. 31, 1962
[1962] 180 p
(Contract NASw-104)
(NASA-CR-56498; PWA-2206, Vol. III) CFSTI: HC $5.00/MF $1.00 CSCL 20M

A compilation of over 100 photographs and graphs is presented relative to the determination of the emissivity of materials. The photographs are concerned mainly with the equipment utilized in the determinations. The graphs give the total hemispherical emittance versus temperature, time, and wavelength plots of refractory metals, oxides, carbides, and titanates. C.T.C.

N66-19499*# Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS, VOLUME II Interim Final Report, Jul. 1, 1959–Dec. 31, 1962
[1962] 200 p
(Contract NASw-104)
(NASA-CR-56497; PWA-2206, Vol. II) CFSTI: HC $5.00/MF $1.25 CSCL 20M

Tables of emissivity measurements on various refractory metals, oxides, carbides, and titanates are presented. These include tabulations of such parameters as elapsed time, pressure, and optical pyrometer recordings. C.T.C.

N66-19501*# Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS, VOLUME I Interim Final Report, Jul. 1, 1959–Dec. 31, 1962
[1962] 273 p refs
(Contract NASw-104)
(NASA-CR-56496; PWA-2206, vol. I) CFSTI: HC $6.00/MF $1.50 CSCL 20M

Results of a program to determine the thermal emittance of candidate materials for use in space radiators are presented. Measurement techniques were developed and facilities constructed which permitted the determinstion of spectral normal and total hemispherical emittance at elevated temperatures. Several methods of applying high emittance coatings were investigated, with the two most successful being thermal spraying and aluminum-phosphate bonding. The emittance measurements were made at temperatures ranging from 200° F to 3100° F, and at pressures as low as 4×10^{-9} mm Hg. Emittance changes resulting from exposure to elevated temperatures for periods up to 900 hours were determined. Of the sixty materials tested in the program the better coating materials can be divided into three major groups: (1) single and complex oxides of titanium or binary oxide mixtures with titanium as one of the two constituents; (2) single and complex oxides of iron, nickel, and chromium; and (3) a miscellaneous group constituted primarily of carbon and its compounds and of boron. C.T.C.

N66-19519*# United Nuclear Corp., White Plains, N. Y.
THERMAL PROPERTIES OF SOLID AND POROUS TUNGSTEN AT TEMPERATURES TO 5000°F
S. L. Israel, T. D. Hawkins, and S. C. Hyman Washington, NASA, Mar. 1966 50 p refs
(Contract NAS3-3205)
(NASA-CR-402) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An experiment was conducted to determine the thermal conductivity of solid and porous tungsten at temperatures up to 5000°F. The method used was to measure the temperature distribution on the top surface of a cylindrical specimen heated in a vacuum by r-f induction currents and radiating freely. The thermal conductivity was determined by equating the axial heat flux within the specimen to the radiation flux at the center of the top surface. A digital computer program was used to relate the axial heat flux within the specimen to the temperature distribution on the top surface. The results of this computer study were used to determine a proportionality factor that permits calculating the axial temperature gradient and heat flux at the center of the top surface from the measured top surface temperature distribution. The thermal conductivity of solid tungsten was found to vary from 76 Btu/hr-ft-°F at 3000°F to 66 Btu/hr-ft-° F at 5000° F. The thermal conductivities calculated for porous tungsten specimens are 10 to 15% of the

solid thermal conductivity. Thermal conductivity data for the porous specimens vary little with temperature, indicating that internal radiation had no significant effect on the effective thermal conductivity. Author

N66-19549# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE EFFECTS OF EXTREME ULTRAVIOLET RADIATION ON THE REFLECTANCE OF THERMAL CONTROL SURFACE COATINGS

James Mc Mahon Cowie (M.S. Thesis) Aug. 1965 66 p refs (GSF/MECH/65-32; AD-625442) CFSTI: HC $3.00/MF $0.75

The effects of ultraviolet radiation in the 500A to 2,000A wavelength region on the spectral reflectance and integrated solar absorptance of three thermal control surface coatings were investigated. The coatings investigated were polished 99.99+% aluminum, and silicone alkyd and melamine modified polyvinyl butyral pigmented 60% by volume with titanium dioxide (TiO_2). Samples of the coatings were exposed for 96 hours in 0.000001 Torr vacuo to radiation from a capillary discharge of hydrogen gas. The spectral reflectance in the 4,000A to 7,000A and 20,000A to 150,000A regions was determined before and after the 96 hour exposure periods. It was found that the maximum decrease in spectral reflectance occurred between 4,200A and 4,600A and was equal to 0.10 for the silicone alkyd/TiO_2, 0.07 for the melamine modified polyvinyl butyral/TiO_2, and 0.06 for the polished aluminum. The integrated solar absorptance was calculated before and after the exposure periods. It was found that the integrated solar absorptance changed from 0.196 to 0.219 for the silicone alkyd/TiO_2, from 0.232 to 0.248 for the melamine modified polyvinyl butyral/TiO_2, and from 0.27 to 0.30 for the polished aluminum. Author (TAB)

N66-19555# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMAL RESISTANCE OF TAIL CONNECTIONS OF TURBINE BLADES

O. T. Il'chenko and V. M. Kapinos 30 Nov. 1965 17 p refs Transl. into ENGLISH from Energmashinostr. (Moscow), v. 5, no. 6, 1959 p 23–26

(FTD-TT-65-680/1+2+4; AD-625242) CFSTI: HC $1.00/MF $0.50

The report discusses a calculated determination of thermal resistance of tail sections of Laval's Y-shaped, arborescent type turbine blade. TAB

N66-19573# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BASES OF BURNER THEORY FOR LIQUID FUEL WITH GAS GENERATOR

N. S. Lamekin 24 Nov. 1965 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 11, 1960 p 103–107

(FTD-TT-65-1034/1+2+4; AD-624915) CFSTI: HC $1.00/MF $0.50

Dispersion and decomposition is studied in a gas generator liquid fuel stream. Analyses show that the cause of dispersion may be due to the cavitation processes, causing decomposition of the stream while still in the sprayer channel. Included are comparisons of sonic pressures for given generator powers, and a step-by-step description of the construction of a gas generator sprayer. C.T.C.

N66-19594*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

HEAT-SHIELD ABLATION MEASUREMENTS USING RADIOISOTOPE TECHNIQUES

George W. Brandon, Jr. Washington, NASA, Mar. 1966 16 p refs

(NASA-TN-D-3329) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A method is presented for applying nucleonic techniques to the measurement of heat-shield surface recession rates during reentry. The method uses a radioactive "line" source embedded in the heat-shield material. A portions of the radioactive source ablate with the heat-shield during reentry, progressive activity decreases are monitored by a miniaturized detection system. Accuracy of the method is developed and some examples of ablation profiles determined by this method are presented and discussed. Author

N66-19633*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FAR-INFRARED REFLECTANCE OF SPACECRAFT COATINGS

D. K. Edwards and W. M. Hall 31 Jan. 1966 20 p refs Presented at the AIAA Thermophysics Specialist Conf., Monterey, Calif., 13–15 Sep. 1965 Submitted for Publication

(Contract NAS7-100)

(NASA-CR-71187; JPL-TR-32-873) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Reflectances and transmittances as a function of wavelength are reported for 17 specimens of painted aluminum and paint films. Such measurements were made with a directional integrating-sphere reflectometer in the 0.33- to 2.5-μ region, a directional heated-cavity reflectometer in the 1.5- to 23-μ region, and a far-infrared reciprocal paraboloid reflectometer in the 20- to 61-μ region. The spectral range thus includes 98% of the room-temperature emission spectrum as well as 98% of the extraterrestrial solar spectrum. Coatings of clear resins on aluminum were discovered to have high reflectances in the far-infrared when the film thicknesses were approximately 25 μ or thinner. Reflectance data for the clear-resin-coated aluminum were found to be predictable with some accuracy from the measurements of binormal transmittance (infrared transparency) of resin films together with use of the Fresnel relations. Pigmented paint resins were found to have low reflectances in the far-infrared region investigated even when the film thicknesses on aluminum substrates were as small as 25 μ. Author

N66-19685# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PERTURBATIONS OF SUPERSONIC FLOW CAUSED BY DISCRETE OR CONTINUOUSLY DISTRIBUTED HEAT AND MASS FLOWS

N. D. Kovalenko 14 Dec. 1965 8 p ref Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), no. 5, 1965 p 684–686

(FTD-TT-65-1619/1+4; AD-625243) CFSTI: HC $1.00/MF $0.50

The equations which describe the flow of an ideal gas and the perturbations of supersonic flow caused by discrete or continuously distributed heat and mass flows are discussed. E.E.B

N66-19733*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COOLING CHARACTERISTICS OF AN EXPERIMENTAL TAIL-PIPE BURNER WITH AN ANNULAR COOLING-AIR PASSAGE

William K. Koffel and Harold R. Kaufman Washington, NASA, 26 Feb. 1952 71 p refs
(NACA-RM-E51K23) CFSTI: HC $3.00/MF $0.75 CSCL 20M Declassified)

The effects of tail pipe fuel air ratio (exhaust gas temperatures from approximately 3060° to 3825° R), radial distribution of tail-pipe fuel flow, and mass flow of combustion gas on the temperature profiles of the combustion gas and of the inside wall of the combustion chamber were determined for an experimental tail pipe burner cooled by air flowing through an insulated cooling air passage 1/2 inch in height. Large circumferential variations, existing in the combustion gas temperature near the inside wall, resulted in similar variations in the inside wall temperature for all configurations tested. The configuration having high fuel concentration near the wall presented a more severe cooling problem. Flame spread to the wall depended on radial fuel distribution rather than fuel-air ratio. Mass-flow ratios were determined for an inside wall temperature of 1300° F at 48 and 56 inches downstream of the flame holder. It was shown that the temperature of the structural wall of an insulated tail pipe burner with an inner liner would be practically the same with or without tail pipe burning. E.A.O.

N66-19780# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DISCUSSION OF THE FORMULA USED IN COMPUTING THE AMOUNT OF FUEL REQUIRED TO PRODUCE COMBUSTION GASES AT A GIVEN TEMPERATURE IN A COMBUSTION CHAMBER OR AN AFTERBURNER
Ruey-Shen Tsay 25 Oct. 1965 6 p refs Transl. into ENGLISH from Chi Hsien Kung Ch'eng Hsueh Pao (Peking), v. 12, no. 3, 1964 p 94–96
(FTD-TT-65-174/1+2+3+4; AD-625788) CFSTI: HC $1.00/MF $0.50

A generalization of the formula for calculating the amount of fuel required to produce combustion gases at a given temperature in a combustion chamber or in an afterburner is presented. The applicability of the original formula based on $(CH_3)m$ fuel to other fuels is discussed. Author (TAB)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-18684# McMaster Univ., Hamilton (Ontario). Organic and Associated Terrain Research Unit.
MOBILITY RESEARCH ON SMALL HIGH-MOBILITY VEHICLES
Ottawa, Defence Res. Board, Aug. 1965 56 p refs
(DR-167; AD-475169)

This report is concerned with a comparison of two vehicles, both amphibious and producing exceedingly low ground pressure. Vehicle characteristics and data sheets are included. In this mobility comparison, appraisal of design is limited to those features affecting terrain/vehicle relations as reflected in mobility performance, and is not intended to assess other engineering design features. All testing was done under off-road conditions, and in organic as well as mineral terrain. It was required that the vehicles be tested in the various kinds of organic terrain usually regarded as critical as regards their bearing capacity. Because of time limitations, five types of organic terrain were selected, which together presented those conditions now internationally recognized as critical in trafficability studies. Appraisal of performance in open water and over rugged granitic outcrop landscape was also required. Author (TAB)

N66-18792# Hanford Atomic Products Operation, Richland, Wash.
INDUSTRIAL NOISE CONTROL IS PRACTICAL
P. H. Hutton 21 May 1965 12 p Presented at the Ann. Meeting, Am. Ind. Hyg. Assoc., Seattle, 6 Aug. 1965
(Contract AT(45-1)-1350)
(RL-SA-37; CONF-650808-1) CFSTI: HC $1.00/MF $0.50

An extensive program of noise control has been conducted at the various process sites within the Hanford Atomic Plant. At the outset, criteria were developed to provide a basis for judging the severity of noise conditions and the high noise level areas were surveyed and categorized on the basis of these criteria. This program demonstrated that effective control of industrial noise does not require sophisticated, expensive techniques. This statement is supported by a number of specific examples where glass fiber blanket material, acoustical baffles, mufflers, and simple system modifications were utilized to good effect in combating problems of high noise level. Author (NSA)

N66-18800# Atomic Weapons Research Establishment, Aldermaston (England).
PROTECTION AGAINST FIRE HAZARDS IN THE DESIGN OF FILTERED VENTILATION SYSTEMS OF RADIOACTIVE AND TOXIC PROCESS BUILDINGS
S. E. Smith, F. J. Hall, W. E. Holmes, and A. F. George Jul. 1965 125 p
(AWRE-O-24/65) HMSO: 17s

A number of safety aspects of the design of filtered ventilation systems for radioactive and toxic buildings are considered. These include theoretical and experimental assessments of the heat release from fires of various kinds in workrooms, fume cupboards, glove boxes, and extract systems, the use of spark and flame arrestors, the ignitability of dust deposits in extract systems and filters and the cooling of hot gases in exhaust ducts. As a result of this work, it is possible to formulate principles which should be followed in the layout and design of such systems, in the future; older systems, which are already being modified to include glass paper filters where necessary, have been found not to require any other serious modification as a result of this work. Author (NSA)

N66-19005# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY
3 Mar. 1966 53 p refs Transl. into ENGLISH from Chinese Periodicals *Its* No. 297
(JPRS-34388; TT-66-30828) CFSTI: $2.00

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1. CARE AND MANAGEMENT OF DATED DRUGS H.-c. Chou and J.-t. Hsu p 1–17 refs
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3. PRESENT STATUS OF RESEARCH IN MODERN

TECTONICS Y.-c. Hsu, P. Li, C.-i Li, and I-t. Chiang p 22–37

4. DESCRIPTION OF THE PEI-LIU GROUP—A NEW STRATIGRAPHIC UNIT OF THE MIDDLE DEVONIAN IN CENTRAL SOUTHERN KWANGSI PROVINCE Y. Wang, C.-m. Yu, T.-w. Fang, W.-h. Liao, C.-c. Ten et al p 28–39

5. SYMPOSIUM ON AFFORESTATION AND SAND CONTROL p 40–41

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7. SYMPOSIUM ON FUSARIUM WILT AND VERTICILLIUM WILT OF COTTON T.-s. Liu p 45–47

N66-19014 Joint Publications Research Service, Washington, D.C.

ON THE STANDARDIZATION OF NATURAL ILLUMINATION

N. M. Gusev *In its* Works of the 2d All-Union Conf. on Geographic Aspects of Illumination 16 Feb. 1966 p 3–19 refs (See N66-19013 09-13) CFSTI: $4.00

Data concerning the use of natural illumination in industrial buildings in different regions of the U.S.S.R. are summarized. Comparisons are made between the natural and artificial illumination standards of Britain, France, U.S.A., and U.S.S.R. Principles for perfecting existing standards in the U.S.S.R. and abroad are proposed. M.R.W.

N66-19042*# National Aeronautics and Space Administration, Washington, D.C.

BACKGROUND, GUIDELINES, AND RECOMMENDATIONS FOR USE IN ASSESSING EFFECTIVE MEANS OF CHANNELING NEW TECHNOLOGIES IN PROMISING DIRECTIONS

Richard L. Lesher and George J. Howick Nov. 1965 312 p refs Prepared for the Natl. Comm. on Technol., Automation, and Econ. Progr.

(NASA-TM-X-57276) CFSTI: HC $7.00/MF $1.75 CSCL 13H

Devising means of channeling new technologies, and their utilization for significant purposes other than the original ones are discussed. Recommendations, proposed for solving the problem include: (1) Encouragement from government and private organizations should be given to talented individuals to pursue these goals. (2) The effective use of the technology resource should be established as a national goal at the highest levels. (3) The design of a national facility for technology transfer made up of many coupled user-oriented systems should be considered. (4) Since technical information is a marketable commodity, the user should share in the cost, and those involved in technology channeling should investigate the marketing aspects. (5) Software aspects of mechanized systems including education in abstracting, indexing, and the design of search strategies should be emphasized. (6) All agencies with significant R&D budgets should establish means of identifying new technology they create. Statistics on federal expenditures and programs are included, and several examples of actual and potential technology transfers are given. E.A.O.

N66-19066 Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF PLANNING DESIGN WORK

T. A. Grinchenko and V. V. Shkurba *In its* Probl. in Theoret. Cybernetics 3 Feb. 1966 p 169–177 refs (See N66-19046 09-08) CFSTI: $6.00

This paper discusses the problems involved in organizing a design operation with respect to a calendar plan. The difficulty of such a task lies in the time consuming construction of graphs, even with the aid of high speed computers. However, digital computers can play a significant role in improving the organization for executing a design project. Computers can expand the set of rules and evaluations on the basis of which the design work is planned, they can select the most reasonable plan on the basis of investigations of a large set of variations, and they can do the planning objectively which also plays an important role in controlling the human collective. R.N.A.

N66-19610*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

OUR INVESTMENT IN SPACE TO BRING MANYFOLD RETURNS

29 Sep. 1964 40 p refs

(NASA-TM-X-57301; MS-IS-64-01) CFSTI: HC $2.00/MF $0.50 CSCL 22D

The difficulties involved in the transfer of missile and space technology are discussed, in relation to the time lag that exists between innovation and production, and production to commercial importance. The impact of space exploration on the nation's economy is assessed, and several examples of by-products resulting from this advanced technology are given. The overall benefits which have resulted from the weather and communications satellites are offered as evidence that the space investment will pay off. The tremendous impetus that space research has given to aeronautics, and the possibilities of satellite navigation systems are considered, along with the evaluative techniques and physical examination methodology which have resulted in medical electronics innovations. Developments in new materials, energy sources, cryogenics, and computer technology are summarized, and applications of plasma jet technology are examined. Other areas influenced by space research are listed, and the objectives of NASA's Technology Utilization Department are outlined. M.G.J.

N66-19611*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

OUR INVESTMENT IN SPACE TO BRING MANIFOLD RETURNS First Supplement

May 1965 40 p refs

(NASA-TM-X-57306; MS-IS-65-01) CFSTI: HC $2.00/MF $0.50 CSCL 22D

This supplement discusses the general ways in which space technology influences our lives and describes specific applications of this technology. Several aspects of fabrication, fluid transfer, pressure measurement, ultrasensitive instruments, infrared technology, new materials such as pyrolytic graphite, geodesy and mapping, food and agriculture, and microelectronics are covered. Author

N66-19634*# Washington Univ., St. Louis, Mo. Dept. of Economics.

PRESENT VALUES OF LIFETIME EARNINGS OF COLLEGE OCCUPATIONS

Hugh Folk 27 Dec. 1965 27 p refs

(Grant NsG-342)

(NASA-CR-71035) CFSTI: HC $2.00/MF $0.50 CSCL 05C

The economic returns from a number of occupations commonly entered by college graduates are analyzed, and the results are applied to questions arising from the engineering and scientific labor market. Several measures of the economic return from an occupation are discussed. Expected lifetime earnings are computed by summing the expected earnings of a worker over his lifetime, taking into account his probability of survival. To correct for different time shapes of earnings streams, it was necessary to discount the earnings stream back to the present. The problems of attrition from the occupation, and options from the occupation for evaluation of lifetime earnings are discussed. Computations of present values of expected lifetime earnings for a number of occupations

are given in tabular form. In the engineering labor force, it is concluded that nongraduate engineers do better than the average graduate, but that engineers and scientists are not well paid relative to the professions, selected business occupations, and all college graduates. Possible reasons for the decline in engineering enrollments are presented. E.A.O.

N66-19705* # Missouri Univ., Kansas City.
[A STUDY OOF THE LOCATION OF SCIENTIFIC RESEARCH AS AN ECONOMIC PHENOMENON] Second Semiannual Progress Report, Aug. 1, 1965–Jan. 31, 1966
[1966] 22 p refs
(Grant NGR-26-004-012)
(NASA-CR-71034) CFSTI: HC $1.00/MF $0.50 CSCL 14A

Progress is reported in the study of cost structures in research facilities to establish cost or efficiency criteria for the spatial allocation of funds for scientific research. Specifically, attempts were made to analyze the effects of clustering or agglomeration on the cost of performing certain kinds of research activities. This involves an improvement in the theory of agglomeration, extending the theory to include research, and the empirical documentation of variations produced in costs by the presence of other economic or research activity in the same local area. The following studies are described: (1) Location Patterns of Research Activities; (2) Bibliographic Source Materials Collection; (3) Decentralized Decision Making and Agglomeration Equilibriums in Research; (4) Economies of Scale in Research Agglomerations; (5) Agglomeration Economies and the Location of Industrial Research; and (6) A Theory of Production and Location for the Research Firm. R.R.D.

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